

PRIVATE PILOT (PP)

EXAM BRIEFING GUIDE AND FLIGHT TEST STANDARDS

1. Introduction

This briefing is created to help candidates understand the purpose of this exam.

2. Requirements

Before applying for this exam, you shall meet the following requirements:

1. have your Advanced Flight Student rating (FS3) since more than one month and
2. have at least 50 hours of logged time on IVAN as a Pilot (ATC hours are not taken into account)

3. Applying for the exam

The theoretical and practical exam can be requested by directly accessing your exam status page.

The exam has two parts which shall be successfully validated in this order:

1. Theoretical exam: complete successfully the PP online test
2. Practical exam: examiner will check your theoretical knowledge and your proficiency in VFR flight.

Requests for practical exams are only possible for members of active divisions. Members of inactive divisions will have to change to an active division in order to get higher ratings (R&R 4.6.2.1)

Once your exam has been registered, the examiner will contact you via your e-mail address given on your details page. Before requesting for the exam, check that this e-mail address is valid since it is the only way for the examiner to get in touch with you.

We recommend you to do a practical training in your division prior to applying for this exam.

4. Theoretical Private Pilot Exam

All theoretical exams consist of 20 randomly selected multiple-choice questions (MCQ).

- Each question includes 3 to 5 proposed answers among which only one is correct.
- You have a maximum of 45 minutes to fill in the examination paper, and should you exceed this limit, the exam will be automatically recorded as failed (default failed score = 0/100).
- These MCQ exams are automatically corrected (each question will be marked 0 for a wrong answer or 5 for a right answer).
- The pass-mark for the exam is 75/100 (corresponding to at least 15 correct answers[2]

The theoretical questions are mainly extracted from our training documentation and software manual:
https://www.ivao.aero/training/documentation/index.php?section=fsx
https://www.ivao.aero/training/documentation/index.php?section=pp

All questions are based on ICAO/JAR OPS Rules and Regulations if not stated otherwise in the question.

Note that you can submit your answers as often as you want during the 45 minutes of the exam. Only the last submission will be taken into account. We greatly recommend you submit your examination paper on a regular basis in order to avoid to be marked 0 if you are disconnected or if you exceed the 45 minutes limit.

After your successful theoretical exam, you can apply for the practical part of the exam without delay.

Warning: Our system does not allow the resetting of theoretical exams, as in this case the same exam will appear again. Consequently, the Training department will always refuse to reset unfilled or timed out exams. In order to shorten the time for applying again, members should save their answers on a regular basis so as to avoid the exam being marked 0 if a disconnection or a time out occurs.

5. Practical Private Pilot Exam

The PP exam is a series of tasks to appreciate your ability of using the pilot IVAO software, your basic VFR theoretical knowledge and your practical VFR flying skills.

Note that these are our minimum standards. Your local division may have set additional requirements that should be published on its web site.

5.1. Training material

The training material is available on the IVAO website following these links below:
https://www.ivao.aero/training/documentation/index.php?section=fsx
https://www.ivao.aero/training/documentation/index.php?section=pp
http://www.flightsimbooks.com/flightsimhandbook/
http://www.faa.gov/regulations_policies/handbooks_manuals/aviation/pilot_handbook/
(Especially the following chapters: flight controls, flight instruments and aircraft performance)

5.2. IVAO software and communication modes

You shall use one of any IVAO approved pilot client for the exam with IVAO weather enabled. We discourage the use of other weather sources to ensure examiner and examinee use the same reference.

The examiner will check your ability to correctly use the main functions of the software, mainly:

- establish a text and/or voice communication with active ATC positions,
- retrieve and interpret the ATIS of a controller,
- use the different transponder modes,
- be able to transmit by text on the current ATC frequency and privately,
- retrieve a distant station ATIS, METAR and TAF

We strongly recommend voice communication for the exam. We do not recommend a "text-text" or "text-voice" communication method due to the increased level of difficulty and incompatibilities with certain tasks. Should a member be unable to use voice or the voice/text method due to a medical disability or a poor network connection, please contact the HQ Training Department before requesting the exam in order to establish an individual procedure.

5.3. Theoretical knowledge

You will be assessed on your theoretical VFR knowledge as part of the exam.
During the briefing or at some times during the flight, the examiner will ask you a few short questions regarding the following items:

- Basics of air law: instrument and visual flight rules, weather requirements for VFR flights, airspace classes and structure, types of controlled airspaces, ATC units and positions, transponder codes,
- Chart reading
- VFR procedures: VFR charts interpretation and VFR circuit,
- Navigation: VFR routes, basic use of radio navigation aids, semi-circular rules, transition altitude and transition level,
- Meteorology: METAR and TAF interpretation,
- Flight instruments and aircraft knowledge: principles of altimetry, altimeter settings, airspeeds, basic flight instruments, aircraft characteristics.

5.4. Practical performance during the exam

5.4.1. General requirements

1. A light (L) single engine propeller fixed wing aircraft (such as a Cessna 172, 182, Piper PA28, Mooney M20 or similar) must be used for the flight test (helicopters are not allowed).
2. Make sure you choose an aircraft you know well and are comfortable with.
3. Basic NAV (navigation) equipment available and fully functional including one VOR receiver and one ADF receiver (or similar) Basic COM (communication) equipment is enough to fulfil exam requirements.
4. Use of the autopilot and GPS system are permitted on the exam. However, be aware that autopilot might not be able to fulfil required manoeuvres exceeding the autopilot capabilities, resulting in exam failure. You are free to use the autopilot at your own risk.

5. Your examiner will advise you of the departure and destination airports prior to the exam (it is examiner's choice) and you will have to plan the route yourself. As a general rule, you will be requested to fly between two airports at least 20 nm apart under visual flight rules. In case the nearest airport is too far from the departing field, a local flight may be prescribed.
6. You will be expected to find the necessary VFR charts yourself (check your country's AIS for online chart availability). If you have difficulties doing so, contact your examiner prior to the exam. In all cases, you may have to coordinate with him so as to determinate which charts will be needed.
7. VMC conditions must exist for the flight to be performed. If necessary, the examiner will postpone or relocate the exam or even can accept simulated clear weather conditions.
8. When starting the exam, you will have to decide if the current weather is acceptable for the intended VFR flight.
9. FS daytime is accepted.
10. You should connect at your departure airfield after the examiner asked you to do so, using the following call sign: EXM#### where #### are the last 4 digits of the exam number. Your radiotelephony call sign will be "Exam ####". Your exam number can be found on the exam status page.
11. The examiner may either be connected as an observer and "simulate" an active ATC position or may connect as an active ATC or collaborate with another ATC in charge of the airspace where the exam takes place. In all cases, comply with all instructions normally.
12. Unless you are disconnected from the network, we require you submit your flight plan only once on examiner request while connected and starting the test flight. You should not change any item and/or resubmit your flight plan thereafter.

5.4.2. VFR flight

The test flight will mainly assess the following:

1. Connection at the departing airport,
2. VFR flight plan; unless you are disconnected during the exam, we request that you send your flight plan only once at the beginning of the flight and on request of the examiner,
3. Ground movements from gate/parking area to assigned runway,
4. Take off technique,
5. VFR departure,
6. En-route VFR navigation (accuracy of navigation based on visual references and radio navigation aids, if any); during the flight, your examiner may ask you to make some exercises (turns to specified headings, climbs/descents to assigned altitude, crossing a defined fix at a specified altitude, flying direct to a VOR and a NDB, making a 360°),
7. VFR arrival (entry points, pattern integration),
8. Traffic patterns,
9. Touch and go or go around followed by a 2nd pattern,
10. Full stop landing and taxi to apron/gate,
11. Phraseology (use of correct phraseology, prompt and accurate read back, minimum proficiency in spoken English)

6. Evaluation and marking method

The examiner will score separately all required tasks (including both theoretical questions and practical exercises) on a dedicated marking sheet.

Each score will reflect the exactness and range of your knowledge (for theoretical data) and your ability to accurately execute the exercises (and your performance for doing so).
The maximum score is 100 points. The pass mark is 75/100. In all cases, your examiner will give you the detailed results during the debriefing, so as you can identify your errors and correct them in case the exam is failed.

Certain minimum requirements are expected for some tasks:

- IVAO software knowledge
- Basic VFR theoretical knowledge
- Connecting to the network
- VFR Pattern execution at aerodrome
- Radio communication and basic VFR English proficiencies

Failure to perform these tasks at the specified standard will result in the exam being marked as fail regardless of your overall performance and the final exam mark shall be 49/100 or less down to 0/100 depending on examiner's assessment.

Some special situations may result in an automatic exam failure (maximum score = 49/100):

- Not having the necessary charts for the exam (wrong charts taken or miss one or several charts)
- Connecting on the runway,
- Entering the runway, taking-off or landing without clearance,
- Crashing due to terrain collision or aircraft overstress.

NOTE: The score for those exams will be 49/100 or less depending on the total result of the exam.
This does not mean that the exam is not continued until finished.

An exam is considered as failed and the practical part will stop immediately or will not be performed if:

- Examinee has no charts (score < 49/100)
- Examinee has low theoretical knowledge (score < 35/100)
- Violation against IVAO Rules and Regulation (score = 0/100)
- Examinee does not turn up for the exam and a valid reason is not given within 48 hours. This will cause the exam to be considered as failed (score = 1/100 or 0/100)
- In case you decide to stop the exam at any time after it has begun, your exam will be marked 0/100.

If the examinee fails to arrive for the exam at the time organised, the examiner should wait for 15 minutes. After that period, the examiner can log off the network. The examinee then has 48 hours to provide a valid reason for the failure to attend by email. If no email is received in time the exam will be marked as failed.

Should a PC crash occur which is out of the applicant's control, the exam will have to start again or will be delayed to take place on another day, the decision being up to the examiner.

7. Validation of the exam

After evaluation, your examiner will send his evaluation to the training director who will assign a validator.

The validator will verify the marking based on the comments and marking sheet of the examiner.

If your exam is validated as a success your rating will be updated at 1200z the following day.

The validation process needs a validation delay estimated from one day minimum to an average maximum of one week.



NATIONAL REGULATION FOR PRACTICAL EXAMS

1. Introduction

As the global forum for cooperation among its Member States and the world aviation community, the International Civil Aviation Organization (ICAO) sets and evolves Standards and Recommended Practices (SARPs) for the safe and orderly development of international civil aviation.

In IVAO, ICAO recommended practice is the source of our documentations for theorical and practical examination.

But, ICAO documentations are only recommended practice and not mandatory practice.
Each state can set up its national regulation which can be different from the ICAO recommended practice.

These documents will gather all sources of specific regulations located in active divisions websites.
These documents are mandatory for a practical exam. A practical exam is based on local regulations.

To be active, these national regulations shall be published on active divisions websites and shall not require any additional login.

As all exams can only be performed in active divisions, we present you only the publications published by these divisions.

This document is classified by continent.

- Africa
- North-America
- South-America
- Asia
- Europe
- Oceania

If your division is missing in this document or some links are broken, tell your staff to contact the IVAO training HQ in order to complete this document.

2. Africa

Division	DZ
Country	Algeria
Training Web Site	http://dz.ivao.aero/atc/training/ http://dz.ivao.aero/pilot/training/
Document for specific regulations	http://www.sia-enna.dz/PDF/AIP/GEN/GEN1/GEN1.6.pdf http://dz.ivao.aero/resources/FO_DZ.pdf
Training documentation in National language	N/A
Source of real aviation	http://www.sia-enna.dz/AIP/AIPTout.htm
Other countries concerned by local regulations	N/A
Real commercial regulations	JAR-OPS1

Division	ZA
Country	South Africa
Training Web Site	http://ivao.co.za/za-academy-introduction/
Document for specific regulations	N/A
Training documentation in National language	N/A
Source of real aviation	http://www.caa.co.za/Pages/default.aspx
Other countries concerned by local regulations	N/A
Real commercial regulations	South African CAA

3. North-America

Division	US
Country	**United States of America**
Other areas of US division	Guam, Caribbean (En-Route)
Training Web Site	http://ivaous.org/academy/
Document for specific regulations	http://ivaous.org/main/faa_icao.pdf
Training documentation in National language	http://ivaous.org/academy/
Source of real aviation	https://www.faa.gov/air_traffic/publications/atpubs/aim/index.htm https://www.faa.gov/air_traffic/publications/atpubs/AIP/AIP_w_Amds_1-3_dtd_7-24-14.pdf https://www.faa.gov/air_traffic/publications/ATpubs/ATC/Index.htm https://www.faa.gov/air_traffic/publications
Other countries concerned by local regulations	Puerto Rico, US Virgin Islands, Guam, Northern Mariana Islands, American Samoa
Real commercial regulations	FAA https://www.faa.gov/regulations_policies/faa_regulations/

4. South-America

Division	AR
Country	Argentina
Training Web Site	http://ar.ivao.aero/biblioteca/
Document for specific regulations	**NO**
Training documentation in National language	http://login.ivao.aero/index.php?url=http://ar.ivao.aero/recursos/manuales/IVAO%20ARG%20Manual%20Basico%20ATC%202011.pdf http://login.ivao.aero/index.php?url=http://ar.ivao.aero/recursos/manuales/Manual%20de%20vuelo%20VFR%20Controlado%20(3era).pdf
Source of real aviation	http://ais.anac.gov.ar/
Other countries concerned by local regulations	N/A
Real commercial regulations	CAA - ANAC Argentina

Division	CO
Country	Colombia
Training Web Site	N/A
Document for specific regulations	**NO**
Training documentation in National language	N/A
Source of real aviation	http://www.aerocivil.gov.co/AIS/Paginas/Inicio.aspx
Other countries concerned by local regulations	N/A
Real commercial regulations	RAC - Reglamento Aeronautico Colombiano

Division	VE
Country	Venezuela
Training Web Site	http://training.ivao.org.ve/
Document for specific regulations	**YES**
Training documentation in National language	http://training.ivao.org.ve/
Source of real aviation	http://www.inac.gob.ve/eBook_PagWeb/2015-02-05/html/eAIP/Menu-es-ES.html
Other countries concerned by local regulations	N/A
Real commercial regulations	Venezuelan Aeronautical Regulations

5. Asia

No information available

6. Europe

Division	BE
Country	Belgium
Training Web Site	N/A
Document for specific regulations	**NO**
Training documentation in National language	**NO**
Source of real aviation	http://www.belgocontrol.be/website/eaip/eAIP_Main/html/index-en-GB.html
Other countries concerned by local regulations	N/A
Real commercial regulations	OPS-CAT http://easa.europa.eu/air-operations

Division	DE
Country	Germany
Training Web Site	http://www.ivao.de/trainingsdepartment/trainingsdepartment.html
Document for specific regulations	**NO**
Training documentation in National language	http://www.ivao.de/trainingsdepartment/trainingsunterlagen.html
Source of real aviation	http://www.ead.eurocontrol.int
Other countries concerned by local regulations	N/A
Real commercial regulations	OPS-CAT http://easa.europa.eu/air-operations

Division	FR
Country	France
Other areas of FR division	French Guyana, Guadeloupe, Martinique, Reunion Island, Mayotte
Training Web Site	http://www.ivao.fr/dep/instruction/Manuels/Ipack-FR_V2/Debut_Ici.html
Document for specific regulations	http://www.ivao.fr/dep/instruction/Manuels/Ipack-FR_V2/pdf/DIFF_FR_OACI.pdf
Training documentation in National language	http://www.ivao.fr/dep/instruction/Manuels/Ipack-FR_V2/Debut_Ici.html http://www.ivao.fr/dep/instruction/guides.html
Source of real aviation	http://www.sia.aviation-civile.gouv.fr/
Other countries concerned by local regulations	French Guyana, St Pierre & Miquelon, Guadeloupe, Martinique, Reunion Island, Mayotte, St Barthelemy, French Polynesia, New Caledonia, Wallis & Futuna
Real commercial regulations	OPS-CAT http://easa.europa.eu/air-operations

Division	GR
Country	**Greece**
Training Web Site	http://www.ivaohellas.net
Document for specific regulations	http://www.ivaohellas.net http://www.hcaa.gr/hellasais/aipdocs/eaip/pdf/gen1/gen17.pdf
Training documentation in National language	http://www.ivaohellas.net
Source of real aviation	http://www.hcaa.gr/hellasais/aipdocs/login/default.asp http://www.hcaa.gr/home/index.asp?lang=2 http://www.eeeke.gr/index_files/ENGLISH_HOME.htm
Other countries concerned by local regulations	N/A
Real commercial regulations	OPS-CAT http://easa.europa.eu/air-operations

Division	IT
Country	**Italy**
Training Web Site	http://web.ivao.it/index.php?option=com_content&view=section&id=9&Itemid=62&lang=it
Document for specific regulations	http://web.ivao.it/index.php?option=com_content&view=category&id=55&Itemid=128&lang=it
Training documentation in National language	http://web.ivao.it/index.php?option=com_content&view=category&id=55&Itemid=128&lang=it
Source of real aviation	http://www.enav.it/portal/page/portal/PortaleENAV/Home http://web.ivao.it/index.php?option=com_content&view=article&id=327&Itemid=175&lang=it
Other countries concerned by local regulations	N/A
Real commercial regulations	OPS-CAT http://easa.europa.eu/air-operations

Division	NL
Country	**The Netherlands**
Training Web Site	http://nl.ivao.aero/training http://tms.nl.ivao.aero
Document for specific regulations	**NO**
Training documentation in National language	http://nl.ivao.aero/training
Source of real aviation	http://www.ais-netherlands.nl/aim/index.html
Other countries concerned by local regulations	N/A
Real commercial regulations	OPS-CAT http://easa.europa.eu/air-operations

Division	PT
Country	**Portugal**
Training Web Site	http://ivao.pt/portal/index.php/academy (login required)
Document for specific regulations	http://www.nav.pt/ais/cd/2015-05-28-AIRAC/html/index.html
Training documentation in National language	http://ivao.pt/portal/index.php/academy/guias-pt
Source of real aviation	http://www.nav.pt/ais/ http://www.nav.pt/ais/cd/
Other countries concerned by local regulations	N/A
Real commercial regulations	OPS-CAT http://easa.europa.eu/air-operations

Division	TR
Country	**Turkey**
Training Web Site	http://www.ivaotr.org/traning/ (special login required)
Document for specific regulations	**YES**
Training documentation in National language	http://www.ivaotr.org/pilot/index.php?page=docs http://www.ivaotr.org/atc/index.php?page=docs
Source of real aviation	http://web.shgm.gov.tr/
Other countries concerned by local regulations	N/A
Real commercial regulations	OPS-CAT http://easa.europa.eu/air-operations

7. Oceania

No information available



AIR TRAFFIC SERVICES

1. Introduction

As for any other form of transportation, there is an inherent need to provide certain services to air traffic so that it can be conducted in a safe and orderly manner.

Air Traffic Service (ATS) can form the basis for establishing the day-to-day requirement of the service provided to aircraft.

The term "ATS" has been defined as being a generic term meaning various flight information service, alerting service, air traffic advisory service, air traffic control service, area control service, approach control service or aerodrome control service.

1.1. National responsibility

The planning for and the execution of air traffic services (ATS) is essentially a national responsibility unless agreements have been made amongst states to conduct ATS as a joint effort for a defined area covering more than one state or for areas where no sovereign rights are exercised (ex: high sea).

In IVAO, the execution of air traffic services is delegated to divisions (national responsibility). Some agreements are possible and may be coordinated by IVAO HQ or several divisions to establish multidivisional airspace or specific agreement.

Furthermore, a close interrelationship between national services of adjacent states is necessary

1.2. Special operation services

In many states, the military services constitute a rather important part of the airspace users.
In some states, military authorities have therefore established their own ATS in parallel with the civil ATS system in order to provide for their specialized operations (ex: fighter training, interceptions, low-level missions, special air exercises…).

In IVAO, the military services are part of special operations department (HQ and/or Division) and can be activated when a specific event is planned.

During, these specific operations, the co-existence of a civil as well as military ATS must not result in competition and inefficient use of the airspace.

2. Objectives

The objectives of the air traffic services shall be to:

- Prevent collisions between aircraft
- Prevent collisions between aircraft in the manoeuvring area and obstructions in that area
- Expedite and maintain an orderly flow of air traffic
- Provide advice and information useful for the safe and efficient conduct of flights
- Notify appropriate organizations regarding aircraft in need of search and rescue aid, and assist such organizations as required.

2.1. Division of ATS

In order to accomplish the previous objectives, the air traffic services are sub-divided into three services:

1. **Air traffic control service** will accomplish the objectives of preventing all collisions between aircraft and expediting and maintaining an orderly flow of air traffic
2. **Flight information service** will accomplish the objectives of providing advice and information useful for the safe and efficient conduct of flights
3. **Alerting service** will accomplish the objectives of notifying appropriate organizations regarding aircraft in need of search and rescue.

2.2. Air traffic service requirement

All air traffic services units shall be supplied with up-to-date information on existing and forecast meteorological conditions as necessary for the performance of their respective functions.

A controlled flight shall be under the control of **only one air traffic control unit at any given time**.

In IVAO, each ATC can have weather information using IvAc software (METAR).

Units providing area control service shall be supplied with:

- SIGMET and AIRMET information, special air-reports, current meteorological reports and forecasts, particular emphasis being given to the occurrence or expected occurrence of weather deterioration
- Current pressure data for setting altimeters, for locations specified by the flight information centre or area control centre concerned

Units providing approach control service shall be supplied with:

- Current meteorological reports and forecasts for the airspace and the aerodromes under their responsibility
- Current pressure data for setting altimeters, for locations specified by the unit providing approach control service.
- Current surface wind
- Runway visual range measurement (RVR)

Units providing tower control service shall be supplied with:

- Current meteorological reports and forecasts for the airspace and the aerodromes under their responsibility
- Current pressure data for setting altimeters, for the location concerned
- Current surface wind
- Runway visual range measurement (RVR)
- Operationally significant conditions of the movement area, including the existence of temporary hazards, and the operational status of any associated facilities at the aerodrome

3. Air control service - ATS

3.1. Application

Air traffic control service or ATS shall be provided:

- to all IFR flights in airspace classes A, B, C, D and E
- to all VFR flights in airspace classes B, C and D
- to all special VFR flights
- to all aerodrome traffic at controlled aerodromes

3.2. Operation

In order to provide air traffic control service, an air traffic control unit shall:

- Be provided with information on the intended movement of each aircraft, or variations thereof, and with current information on the actual progress of each aircraft;
- determine from the information received, the relative positions of known aircraft to each other;
- Issue clearances and information for the purpose of preventing collision between aircraft under its control and of expediting and maintaining an orderly flow of traffic;
- Coordinate clearances as necessary with other units whenever an aircraft might otherwise conflict with traffic operated under the control of such other units or before transferring control of an aircraft to such other units.

Information on aircraft movements shall enable an analysis in order to maintain an efficient flow of air traffic with adequate separation between aircraft.

Clearances issued by air traffic control units shall provide separation**:**

- between all flights in airspace Classes A and B;
- between IFR flights in airspace Classes C, D and E;
- between IFR flights and VFR flights in airspace Class C;
- between IFR flights and special VFR flights;
- between special VFR flights when so prescribed by national ATS regulations.

When requested by an aircraft, in airspace Classes D and E, a flight may be cleared without separation with respect to a specific portion of the flight conducted in visual meteorological conditions when the national regulation permits such flights.

Separation by an air traffic control unit is obtained by at least one of the following:

- vertical separation, obtained by assigning different levels
- horizontal separation, obtained by providing longitudinal separation, by maintaining an interval between aircraft operating along the same, converging or reciprocal tracks, or lateral separation, by maintaining aircraft on different routes or in different geographical areas
- composite separation, consisting of a combination of vertical separation and horizontal separation

3.3. Air traffic control service sub-type

The air traffic control (ATC) service is divided in three sub-parts as follows:

1. **Area control service (ACC)**: the provision of air traffic control service for en-route controlled flights except the aircraft associated with arrival or departure routes or ground movements.
2. **Approach control service (APP)**: the provision of air traffic control service for controlled flights associated with arrival or departure except the aircraft associated with ground movements.
3. **Aerodrome control service (TWR)**: the provision of air traffic control service for aerodrome traffic at and in the vicinity of an aerodrome

3.3.1. Area control service (ACC)

The area control service shall be provided by the area control centre (ACC) or, where no area control centre is established, by the unit providing approach control service in a control area of limited extent. This air traffic control service is provided for en-route controlled flights except the aircraft associated with arrival or departure routes or ground movements.

Coordination plays an essential part in the provision of area control service and the efficiency of operation of an ACC can be significantly affected by it.
The coordination aspects can be split in several types:

- Coordination with adjacent ACC
- Coordination with associated ATC units providing services within the same FIR
- Coordination within the ACC concerned

In IVAO, area control centres are taken by _CTR positions. The FSS (Flight Service Station) position shall not give any area control services.

3.3.2. Approach control service (APP)

The approach control service shall be provided by an approach control unit when it is necessary or desirable to establish a separate unit or, by an aerodrome control tower or area control centre when it is necessary to combine the functions of the approach control service under the responsibility of one unit . This air traffic control service is provided for controlled flights associated with arrival or departure except the aircraft associated with ground movements

Measures should be taken to ensure the possible mix of instrument flight rules (IFR) and visual flight rules (VFR) operations in order not to impair the safety of flight operations.

The co-operative arrangements between approach controller and aerodrome control tower(s) should be based on considerations of an operational nature only so as to ensure the optimum flow of air traffic.

It has been found that at some busy major aerodromes, the arrangement, whereby departing traffic is transferred directly from aerodrome control tower to a departure only control position, has contributed to an optimum flow of considerable amounts of air traffic while keeping the workload within manageable proportions. This arrangement depends specifically on the local situation and it should only be applied after careful consideration of all relevant factors by all parties concerned.

The internal arrangement for sharing the task of providing approach control service is possible using a basic split between those controlling arriving and those controlling departing traffic is the most suitable arrangement, unless other arrangements have been made whereby departing air traffic is directly transferred from the aerodrome control tower to the associated en-route controller.

Operational consideration shall be based on the safe and efficient flow of air traffic before any other consideration.

In IVAO, approach control units are taken mainly by _APP positions and also partially by _DEP positions which take only the departure traffic.

3.3.3. Aerodrome control service (TWR)

The Aerodrome control service shall be provided by an aerodrome control tower.
This air traffic control service is provided for aerodrome traffic at and in the vicinity of an aerodrome.

The internal arrangement for sharing the task of providing aerodrome control service is possible where more than one controller is present:

- Runway management, ground management and Clearance management can be split over several ATC control positions
- Independent parallel runway management can be split over several ATC control positions
- Large ground or separate Civil/Military apron and taxiway can be split over several ATC control positions

In IVAO, this split is possible using DEL, GND, and TWR positions as IFR clearance delivery, ground management, runway management.

3.3.4. Division of responsibility

The division of responsibilities between TWR and APP and between APP and ACC cannot be rigidly defined because the responsibilities depend very much on local conditions which vary from location to location:

- Remember that this possibility of extended control which is permitted by the regulation is subject to your national regulation authorization.

- Remember that controlling outside your responsibility area is forbidden in IVAO except when national regulation permits it, or when it is published clearly on charts.

It should be noted that, depending on traffic conditions, the provision of certain parts of ATC service may be restricted to those times or periods when the service in question is actually required.

But, this shall, under no circumstances, result in a decrease of flight safety.

In IVAO, the provision of several sub-types of ATC service may be cumulated under the same air traffic controller. (Example: CTR can control APP and TWR).

3.4. Air traffic control clearances

An air traffic control clearance shall indicate:

- aircraft identification as shown in the flight plan
- clearance limit
- route of flight
- level(s) of flight for the entire route or part thereof and changes of levels if required
- any necessary instructions or information on other matters such as approach or departure manoeuvres, communications and the time of expiry of the clearance

Standard departure and arrival routes and associated procedures should be established to facilitate:

- the safe, orderly and expeditious flow of air traffic
- the description of the route and procedure in air traffic control clearances

The flight crew shall read back to the air traffic controller safety-related parts of ATC clearances and instructions which are transmitted by voice.

The following items shall always be read back:

- ATC route clearances;
- clearances and instructions to enter, land on, take off on, hold short of, cross and backtrack on any runway
- runway-in-use
- altimeter settings
- SSR codes
- level instructions
- heading and speed instructions
- transition levels

Other clearances or instructions, including conditional clearances, shall be read back or acknowledged in a manner to clearly indicate that they have been understood and will be complied with.

The controller shall listen to the read-back to ascertain that the clearance or instruction has been correctly acknowledged by the flight crew and shall take immediate action to correct any discrepancies revealed by the read-back.

An **air traffic control clearance shall be coordinated between air traffic control units to cover the entire route** of an aircraft.

An aircraft shall be cleared for the entire route to the aerodrome of first intended landing:
- when it has been possible, prior to departure, to coordinate the clearance between all the units under whose control the aircraft will come
- when there is reasonable assurance that prior coordination will be effected between those units under whose control the aircraft will subsequently come

When coordination has not been achieved or is not anticipated, **the aircraft shall be cleared only to that point where coordination is reasonably assured**. Prior to reaching such point, or at such point, **the aircraft shall receive further clearance or holding instructions**

Air traffic flow management (ATFM) shall be implemented for airspace where air traffic demand at times exceeds, or is expected to exceed, the declared capacity of the air traffic control services concerned.

The movement of persons or vehicles including towed aircraft in the manoeuvring area of an aerodrome shall be controlled by the aerodrome control tower as necessary to avoid hazard to them or to aircraft landing, taxiing or taking off.

Note that only follow-me cars can be simulated in IVAO.

3.5. Provision of radar

Radar systems should provide for the display of safety-related alerts and warnings, including conflict alert, conflict prediction, minimum safe altitude warning and unintentionally duplicated SSR codes.

4. Flight information Service (FIS)

Flight information service will accomplish the objectives of providing advice and information useful for the safe and efficient conduct of flights.

Flight information service shall be provided to all aircraft which are likely to be affected by the information.

Flight information service does not relieve the pilot-in-command of an aircraft of any responsibilities and the pilot-in-command has to make the final decision regarding any suggested alteration of flight plan.

The provision of air traffic control service shall have precedence over the provision of flight information service whenever the provisions of air traffic control service so requires.

4.1. Scope

Flight information service provided to flights shall include the provision of information concerning:

- weather conditions reported or forecast at departure, destination and alternate aerodromes
- collision hazards to aircraft operating in airspace classes C, D, E, F and G
- status on navigation aids
- exercises in progress and airspace reservation (Restricted zone)
- any available information of surface sea vessels in the area for flight over water areas when requested by a pilot (not simulated by IVAO except in some specific scenery)

The information of which may constitute a collision hazard to the aircraft informed, will sometimes be incomplete and air traffic services cannot assume responsibility for its issuance at all times or for its accuracy.

In addition to previous items, flight information service shall include the provision of pertinent:

- SIGMET and AIRMET information
- information concerning volcanic eruptions and volcanic ash clouds (not simulated in IVAO)
- information concerning the release into the atmosphere of toxic chemicals (not simulated in IVAO)

- information on the serviceability of navigation aids
- information on changes in condition of aerodromes and associated facilities, including information on the state of the aerodrome movement areas
- any other information likely to affect safety

Flight information service provided to VFR flights shall include the provision of available information concerning traffic and weather conditions along the route of flight that are likely to make operation under the visual flight rules impracticable.

Where flight information service is the only service provided for en-route traffic, it is generally provided to aircraft by a flight information centre (FIC).

4.2. Aerodrome flight information service (AFIS)

Where flight information service is the only service provided to aircraft at and in the vicinity of a given aerodrome, it is generally provided to aircraft by aerodrome flight information service (AFIS).

4.3. ATIS - automatic terminal information service

The meteorological information and operational information concerning navigation aids and aerodromes included in the flight information service shall, whenever available, be provided in an operationally integrated form.

Operational flight information service broadcasts, when provided, should consist of messages containing integrated information regarding selected operational and meteorological elements appropriate to the various phases of flight. These broadcasts should be of three major types, i.e. HF, VHF and ATIS.

In IVAO, the automatic terminal information service named ATIS is the main flight information broadcast.

When ATIS is provided:

- the information communicated shall relate to a single aerodrome (see note below)
- the information communicated shall be updated immediately when a significant change occurs
- the preparation and dissemination of the ATIS message shall be the responsibility of the air traffic services
- individual ATIS messages shall be identified by a designator in the form of a letter of the ICAO spelling alphabet. Designators assigned to consecutive ATIS messages shall be in alphabetical order
- aircraft shall acknowledge receipt of the information upon establishing communication with the ATS unit
- the appropriate ATS unit shall, in the case of arriving aircraft, provide the aircraft with the current altimeter setting when needed
- the meteorological information shall be extracted from the local meteorological report.

Note: Since an approach controller has a separate ATIS in IVAO, ATIS can broadcast information related to several aerodromes.

Information contained in a current ATIS, the receipt of which has been acknowledged by the aircraft concerned, needs not be included in a directed transmission to the aircraft, with the exception of the altimeter setting.

If an aircraft acknowledges receipt of an ATIS that is no longer current, any element of information that needs updating shall be transmitted to the aircraft without delay.

5. Alerting service

Alerting service will accomplish the objectives of notifying appropriate organizations regarding aircraft in need of search and rescue aid

Alerting service shall be provided:

- to all aircraft provided with air traffic control service
- in so far as practicable, to all other aircraft having filed a flight plan or otherwise known to the air traffic services
- to any aircraft known or believed to be the subject of unlawful interference

The alerting service is not implemented in IVAO.
Only a small description of the important points is presented in this documentation.

In IVAO, air traffic controllers shall take charge of all aircraft in emergency state and provide information to all neighbouring controllers concerned with this emergency.

5.1. Application

Flight information centres or area control centres shall serve as the central point for collecting all information relevant to the state of emergency of an aircraft operating within the area concerned and for forwarding such information to the appropriate rescue coordination centre.

In the event of a state of emergency arising from an aircraft while it is under the control of an aerodrome control tower or approach control unit, such unit shall notify immediately the flight information centre or area control centre responsible which shall in turn notify the rescue coordination centre, except that notification of the area control centre, flight information centre, or rescue coordination centre shall not be required when the nature of the emergency is such that the notification would be superfluous.

The aerodrome control tower or approach control unit responsible shall first alert and take other necessary steps to set in motion all appropriate local rescue and emergency organizations which can give the immediate assistance required.

5.2. Notification of rescue phases

Uncertainty phase when

- no communication has been received from an aircraft within a period of thirty minutes after the time a communication should have been received, or from the time an unsuccessful attempt to establish communication with such aircraft was first made, whichever is the earlier
- an aircraft fails to arrive within thirty minutes of the estimated time of arrival last notified to or estimated by air traffic services units, whichever is the later

Except when no doubt exists as to the safety of the aircraft and its occupants

Alert phase when

- following the uncertainty phase, subsequent attempts to establish communication with the aircraft or inquiries to other relevant sources have failed to reveal any news of the aircraft

- an aircraft has been cleared to land and fails to land within five minutes of the estimated time of landing and communication has not been re-established with the aircraft
- information has been received which indicates that the operating efficiency of the aircraft has been impaired, but not to the extent that a forced landing is likely, except when evidence exists that would allay apprehension as to the safety of the aircraft and its occupants
- An aircraft is known or believed to be the subject of unlawful interference.

Distress phase when:

- following the alert phase, further unsuccessful attempts to establish communication with the aircraft and more widespread unsuccessful inquiries point to the probability that the aircraft is in distress
- the fuel on board is considered to be exhausted, or to be insufficient to enable the aircraft to reach safety,
- information is received which indicates that the operating efficiency of the aircraft has been impaired to the extent that a forced landing is likely
- information is received or it is reasonably certain that the aircraft is about to make or has made a forced landing

Except when there is reasonable certainty that the aircraft and its occupants are not threatened by grave and imminent danger and do not require immediate assistance

The notification shall contain as much of the following information as is available in the order listed:

- INCERFA, ALERFA or DETRESFA, as appropriate to the phase of the emergency;
- agency and person calling;
- nature of the emergency;
- significant information from the flight plan;
- unit which made last contact, time and means used;
- last position report and how determined;
- colour and distinctive marks of aircraft;
- dangerous goods carried as cargo;
- any action taken by reporting office; and
- other pertinent remarks



RADAR SERVICES

1. Introduction

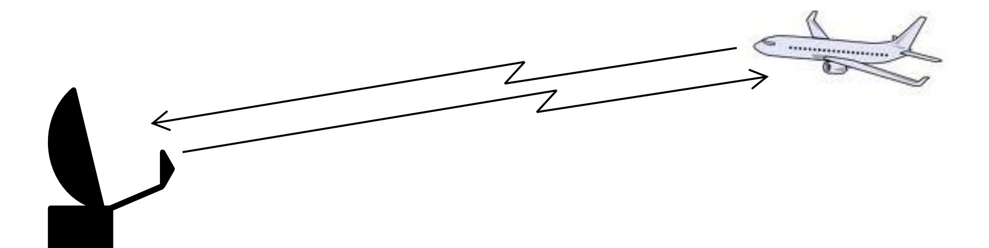
Air traffic control radars are devices used to detect, monitor and guide aircraft within a delimited airspace region.

Several types of radars are used in the framework of civil or military air traffic control.
In IVAO, we have only one Radar system simulated by IvAc software.

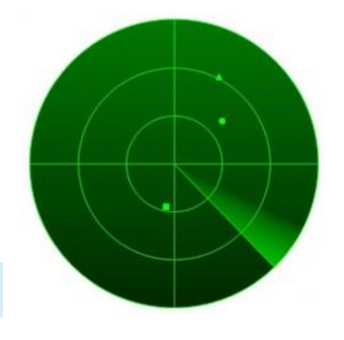
1.1. Primary radar

This type of radar operates using the electromagnetic waves properties, especially the echo.

The primary radar is a turning antenna that emits electromagnetic pulses, meaning a wave front concentrated in time which propagates through air and is reflected by all targets with sizes greater than a given threshold. The radar finally detects the incoming waves after their reflection.



The time difference between the pulse emission and the reflected wave reception is proportional to the distance of the target with respect to the emission antenna. The position of the antenna at the reception, corrected by the fact the antenna is continuously turning, is linked to the azimuthal angle of the target.



Primary radars are unable to detect the altitude of the target.

The emission power of the radar is one of the main specifications which determine the maximum detection range (radar coverage). The introduction of the pulse compression technique has made possible a global reduction of the instantaneous emission power, leading to less expensive devices.

Primary radars are placed in strategic positions within a given region to ensure the largest coverage:

- **Approach primary radars** are located in most of the airports to detect all aircraft flying within and in the vicinity of the airport airspace, in particular those which are not equipped with a transponder.

- **En-route primary radars** are meant to detect all aircraft in transit over a large airspace. They do not exist anymore in Europe since they are very power consuming and heavy to maintain. En-route primary radars have been replaced by secondary radars which are by far much more efficient.

- **Ground primary radars** are also located in some airports to help the controller in regulating the circulation of all vehicles, aircraft or others, within the tarmac and taxiways. This type of radar is useful especially in low visibility conditions.

1.2. Secondary radar

This type of radar operates using the interrogation technique.

The secondary radar transmits a series of electromagnetic pulses, but these pulses are coded in such a way that a transponder system installed inside aircraft system can detect and interpret them.

The transponder of an aircraft detects and decodes the radar pulses (interrogation signal) and emits a series of pulses which code the answer to the interrogation.

The secondary radars operate in "active mode" with respect to primary radars which operate in "passive mode".

The passive answer (primary mode) of the aircraft provides its position while the active answer of the transponder (secondary mode) provides other information (code, altitude, speed…), depending on the type of both the radar and the transponder.

Two types of secondary radars exist:

- **Mode C** (or standard) **secondary radar**: it is used to interrogate aircraft on their transponder code (mode A) and the altitude indicated by their altimeter (mode C).
- **Mode S secondary radar**: it is an evolution of the standard secondary radar and is able to:
  - Make a selective interrogation of all aircraft equipped with mode S transponders and provide data exchange between the aircraft and the radar
  - Provide better data integrity by parity check
  - Provide a more precise altitude information

In IVAO, IvAc software can be considered as Mode S secondary radar.

1.3. Radar used by air traffic control (real aviation)

Radars are able to detect and localize all aircraft within an airspace region.

Radar echoes (eventually coupled to active answers) of a moving aircraft constitute an ensemble of "radar plots" which allow reconstructing a "radar track".

Radar tracks are compiled to generate and display the radar image of the aircraft. All radars placed within a given region have overlapping coverage in order to avoid dead zones. Each of the radars available generates its own image of the aircraft track.

In order to avoid redundant plots in the process of track generation, all radars transmit their plots to a centralized computer which builds up the track.
So, the radar image of an aircraft is often produced by the combination of plots coming from several radars, thus ensuring a higher confidence of the displayed information.

In IVAO, we do not have this complex system, IvAc software makes a perfect view of all aircraft plots without any combination of radar images.

2. Radar services

Radars are used by air traffic control to provide three **types of radar services:**

- Radar Surveillance
- Radar Assistance
- Radar Guidance

Radar services can be provided only to aircraft which are "**radar identified**", which means that the correlation between the radar track and the aircraft is unambiguous.

Some air traffic control units are not able to provide some of the radar services because of their radar performances or the airspace configuration.

2.1. Radar Surveillance

Radar is used to identify and determine the position of all aircraft.

In this framework, radar surveillance is meant to:

- Monitor the separation between each aircraft flying within a controlled airspace where radar separation is provided
- Monitor the position of each aircraft within a controlled airspace where traffic information is provided
- Monitor non-controlled aircraft evolution
- Monitor any significant deviation from the instructions cleared by the controller to the pilots (if applicable)

Pay attention, this service has no communication with the aircraft.

2.2. Radar Assistance

Radar is also used to provide assistance to all aircraft.

In particular, it helps the controller to:

- Provide any information about traffic position and intention, meteorological conditions
- Provide information about any significant deviation from the instructions cleared by the controller to the pilot, or the published flight plan given by the pilot, in particular concerning the correct route and flight level to be flown at.
- Provide necessary assistance and information in case of pilot assistance request, pilot decision to land in alternate aerodrome or in case of emergency.

Pay attention, this service does not give any clearance or instructions to aircraft. The air traffic controller only gives advices, information to help the pilot to make a decision.

2.3. Radar Guidance

Radar is finally used to guide aircraft within a controlled airspace. In particular, it helps the controller to:

- Provide vectors to aircraft in order to ensure their separation and/or make them follow a specific trajectory
- Optimize and regulate the traffic flow (minimize trajectory, avoid level flight, handle level crossing, etc.)

2.4. Radar services provided by each ATC position

On IVAO, all controllers dispose of a radar when using IvAc radar client.
Nevertheless, the radar services that can be provided by the ATC depend on the control position he has in charge:

ATC position	Radar surveillance service	Radar assistance service	Radar guidance service
DEL	NO	NO	NO
GND	YES	PARTIALLY	PARTIALLY
TWR	YES	YES	PARTIALLY
APP	YES	YES	YES
DEP	YES	YES	YES
CTR	YES	YES	YES
FSS	YES	YES	NO

Other ATC positions can be exceptionally opened in the case of specific events (mostly VFR based):

- **AFIS** (**Aerodrome Flight Information Service**) agent at the **TWR** position: in general he does not dispose of a radar and only provides **radar Surveillance and partial Assistance**
- **FIS** (**Flight Information Service**) agent at the **APP** or **CTR** position: in general he does dispose of radar and only provides **radar Surveillance and Assistance** (in some cases only partially).



FLIGHT RULES CHANGE AND Y/Z RULES

1. Introduction

During some general aviation flights, pilots can plan a flight rule change in their flight plan.

When one part of the flight is going to be conducted in IFR and the other one in VFR, or the other way round, pilots must inform the appropriate ATS (Air traffic services).

Pilot shall use Y or Z flight rules to specify this special situation.

2. Yankee or Zulu flight rules

Y flight rules means that the first part of the flight is IFR, thereafter the flight is conducted in VFR.
Z flight rules means that the first part of the flight is VFR, thereafter the flight is conducted in IFR.

In summary, the letters will denote the category of flight rules which the pilot intends to comply:

- **I** when the whole flight will be under IFR
- **V** when the whole flight will be under VFR
- **Y** when the first part of the flight will be under IFR and later changed into VFR
- **Z** when the first part of the flight will be under VFR and later changed into IFR

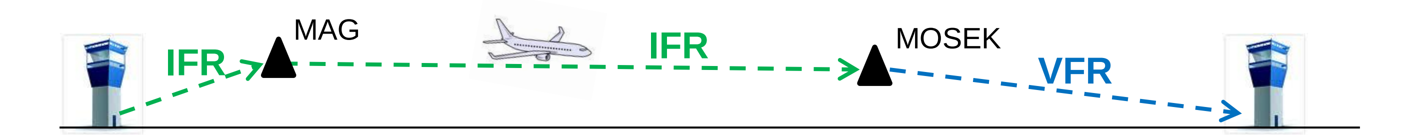
The pilot should specify in the appropriate route item the point or points where that change of flight rules is planned.

2.1. Yankee flight rule example: IFR⇨VFR

When the Flight Rule is Y, then the IFR route has to be filled until the last IFR point.

- Add the key word "**VFR**".
- Then continue with your detailed VFR flight plan; you can use "**DCT**" if this flight plan is not mandatory.

Example:
MAG UZ20 MOSEK **VFR** DCT
This means the flight will depart **IFR** and remain **IFR** till MOSEK, after MOSEK the flight will continue **VFR**



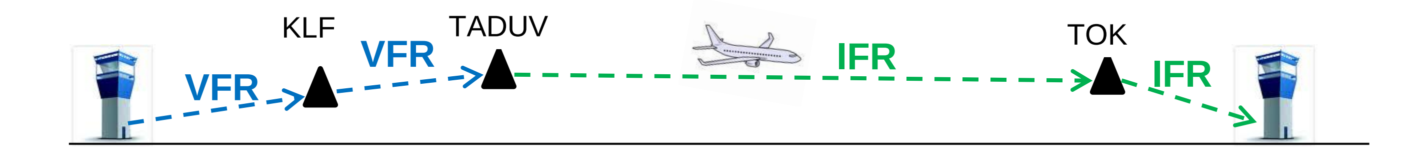
Phraseology:
Pilot: "Request cancelling my IFR flight"
ATC: "After MOSEK, Report VMC to cancel IFR"
Pilot: "At MOSEK, under VMC conditions"
ATC: "**IFR CANCELLED AT** 10:00 UTC, continue descent/navigation under visual flight rules"

2.2. Zulu flight rule example: VFR⇨IFR

When the Flight Rule is Z, then the VFR route has to be filled until the first IFR point.

- Add the key word "**IFR**" after the first IFR point with its requested altitude and true airspeed.
- Then continue with your detailed IFR flight plan until destination.

Example:
KLF DCT TADUV/N0280F140 **IFR** T172 DEJAB L665 TOK
This means the flight will depart **VFR** and remain **VFR** till TADUV, after TADUV the flight will continue **IFR** at FL140 with true airspeed 280 Knots.



Phraseology:
Pilot: "At KLF, request IFR at TADUV"
ATC: "Report TADUV, climb FL140"
Pilot: "At TADUV"
ATC: "IFR activated at 10:00 UTC, route DEJAB"

2.3. Flight rule change in flight

A pilot can change his flight plan and his flight rules during his flight. This must be negotiated with the air traffic controller.

The controller shall prescribe conditions and/or limitations with respect to the submission of flight plans during the flight to ATC units.

2.4. Change from IFR to VFR

A pilot electing to change the conduct of his flight from compliance with the instrument flight rules (IFR) to compliance with the visual flight rules (VFR) shall:

- notify the appropriate air traffic services unit specifically that the IFR flight is cancelled
- communicate thereto the changes to be made to his current flight plan

The change from an instrument flight rules (IFR) flight to a visual flight rules (VFR) flight is only acceptable when a message initiated by the pilot-in-command containing the expression "CANCELLING MY IFR FLIGHT", together with the changes from IFR flight to VFR flight, is sent.

No reply, other than the acknowledgement "IFR FLIGHT CANCELLED AT <time>", should normally be made by the controller.

When the controller knows that instrument meteorological conditions are likely to be encountered along the route, a pilot changing from IFR to VFR flight shall be advised:
"INSTRUMENT METEOROLOGICAL CONDITIONS REPORTED (or FORECAST) IN THE VICINITY OF <location>".

The pilot in command has the responsibility to maintain VMC along his remaining route.

An ATC unit receiving notification of an aircraft's intention to change from IFR to VFR flight shall inform the next controllers to whom the IFR flight plan was addressed for the remaining route. (On the IVAO network, only the next ATC should be informed as there is no flight plan following along the route).

2.5. Change from VFR to IFR

A pilot operating in accordance with the visual flight rules who wishes to change to compliance with the Instrument Flight Rules shall:

- communicate the necessary changes to be effected to his current flight plan
- submit a flight plan to the air traffic services unit and obtain a clearance prior to proceeding IFR when in controlled airspace

This change (from VFR to IFR flight rules) should be asked when the pilot suddenly faces bad weather conditions below VFR minima in order to continue his flight.

3. VFR departure of an IFR

If your flight plan is IFR and you want to take off from a non-controlled and non IFR airfield, you can make a VFR departure under VMC conditions from this airfield.
When climbing to your first route point, you shall call the en-route controller (if connected) in order to get your IFR clearance in the air.

The en-route controller can only give IFR clearance to an aircraft above MRVA. The MRVA is the lowest altitude or flight level that may be assigned by a radar controller to an IFR aircraft.

The pilot shall climb to a safe altitude as soon as possible like the minimum sector altitude if published, or the minimum en-route altitude applicable at the first en-route point.

We recommend calling the en-route controller before take-off in order to negotiate the first contact point and altitude.



HOW TO USE THE RUNWAY

1. Introduction

A runway is a rectangular area of an aerodrome prepared for the landing and take-off of aircraft.

The runway is the most critical part of an airfield. An accident on a runway will affect the airport availability and any accident on a runway generally causes several reasons of damage and injuries in real life.

As a pilot or active ATC (air traffic controller), you must respect elementary security rules presented in this document.

2. Mandatory rules to know as a pilot

2.1. A clearance is mandatory

In a controlled airfield and for a pilot, a clearance from the air traffic controller is mandatory to enter, back-track, cross, land and take-off on the runway.

With no clearance in a controlled air field, the pilot shall not enter and land on any runway.

Pilots must read back all these clearances.

Examples:
ATC: Speed bird 5 4 6, **line up runway** 13 and wait.
Pilot: **line-up runway** 13 and wait, Speed bird 5 4 6

ATC: Alitalia 1 4 4 5, runway 15, **cleared to land**, wind 100 degrees 6 knots
Pilot: **cleared to land** runway 15, Alitalia 1 4 4 5.

2.2. Runway using condition for landing and taking-off procedure

A landing procedure cannot be performed when the runway is occupied.
A take-off procedure cannot be performed when the runway is occupied.

In controlled area, a pilot on short final shall make a go around procedure before the runway threshold if he has not received any landing clearance.

The pilot in command shall initiate a go around procedure if he can see any aircraft, vehicle or obstacle on the runway even though he has received a landing clearance from ATC. He must immediately inform the ATC about the go around.

2.3. Runway use in non-controlled areas

When there is no ATC available in an airfield, you must give your intention using a self-announcement procedure on UNICOM 122.800 MHz frequency.

The first pilot announcing a landing (if he has the runway in sight) or take-off manoeuvres has priority on the runway.

Then, if a second aircraft wants to land, he has to wait or negotiate with this pilot a new priority in accordance with the current position of all aircraft.

3. Mandatory rules to know as an air traffic controller

3.1. A clearance is mandatory

In a controlled airfield, as an air traffic controller, it is mandatory to give a clearance to a pilot in order to let him enter, back-track, cross, land and take-off on the runway.

Without clearance, the pilot shall not enter and land on any runway.

Pilots must read back all these clearances.

3.2. Runway using condition for landing and taking-off procedure

After being given a landing or taking off clearance, the runway available in front of the aircraft cannot be used until the aircraft has vacated the runway or has executed a go-around procedure.

After being given a landing or take off clearance, the runway cannot be used any more for a landing or a take-off before the aircraft who has been given the clearance has vacated the runway or has executed a go around.

An air traffic controller shall manage all runways with the best rate of usability. He must follow the basic rule described below:

When an ATC delivers a line up and take-off clearance, he has to make sure that the taking-off aircraft has enough time to free the runway before the following aircraft on final is landing.

4. Runway occupied or runway free

4.1. Definition

Whether the aircraft is controlled or not, a runway is considered occupied when:

- An aircraft or a vehicle is on the runway whether rolling, taxiing or waiting.
- An aircraft is landing on the runway from runway threshold until the touchdown
- An aircraft is taking-off until the runway limits are left
- An aircraft is making a touch and go or a low pass until the runway limits are left
- An aircraft or a vehicle are between the runway and the holding point bar

The runway is considered occupied if the different cases above will be effective with a clearance already given (taking off, landing, crossing, taxiing …).

For example, a runway is considered occupied if:
A landing clearance is already given to an aircraft whether the aircraft overflies the runway or not.
A taking-off clearance is already given to an aircraft on the runway or at the holding point.
A runway crossing clearance is already given to an aircraft until he vacates the runway.

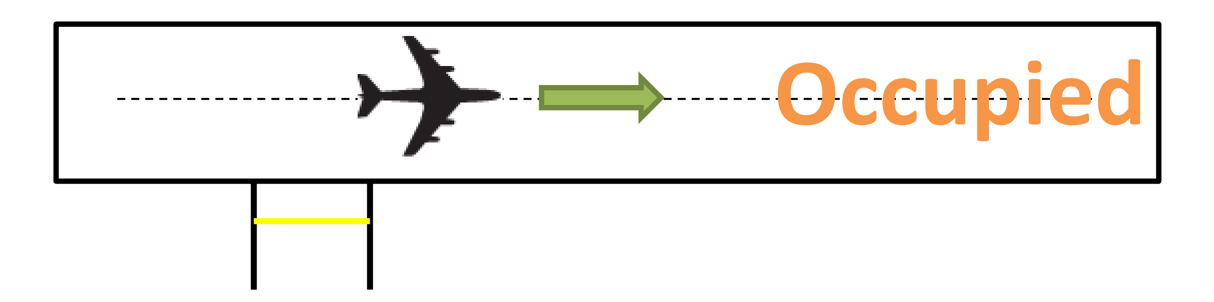
Touch and Go, Stop and Go, Low Pass clearances are considered as landing and taking/off clearances.

For airports which have multiple runways, the bare basic of the security is the same, but some rules must be added. These special rules will be part of another document.

4.2. Examples

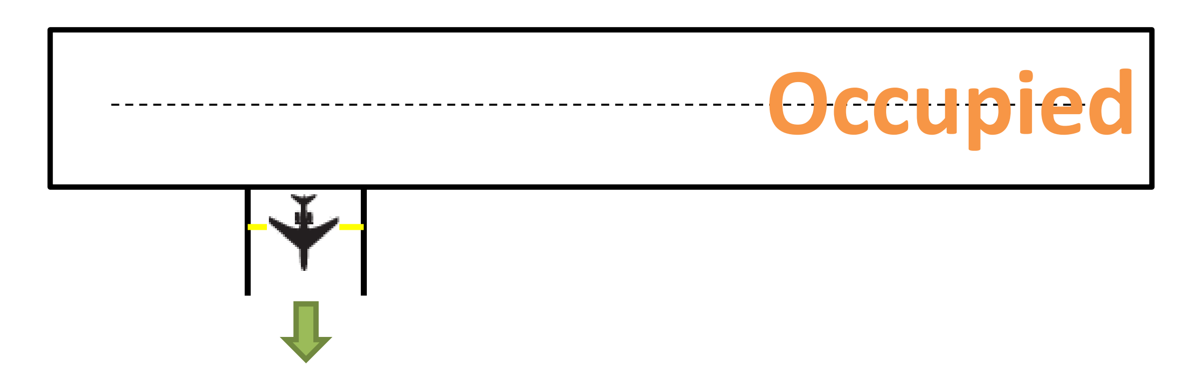
Below, an example of an aircraft on runway taxiing, crossing, back-tracking, taking-off or landing:

Runway is o**ccupied**.



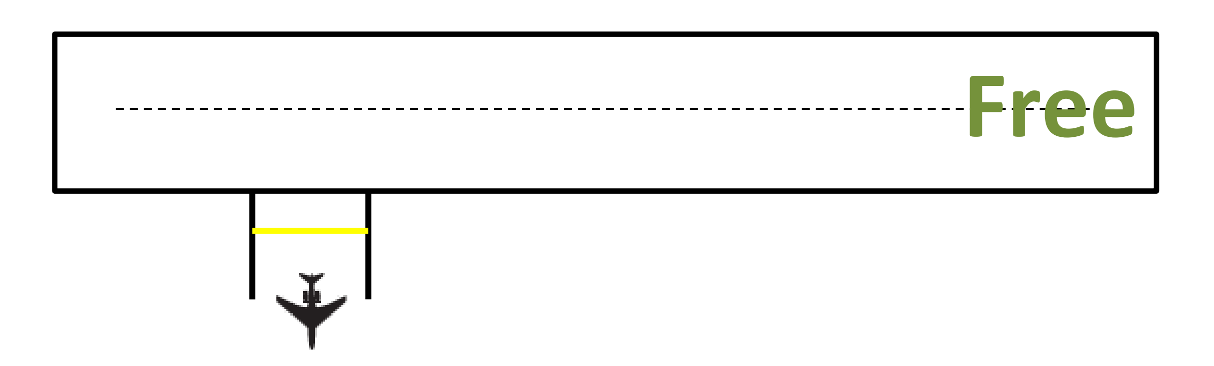
Below, an example of an aircraft in progress of a runway vacation but the holding point bar is not behind the aircraft:

Runway is o**ccupied**.



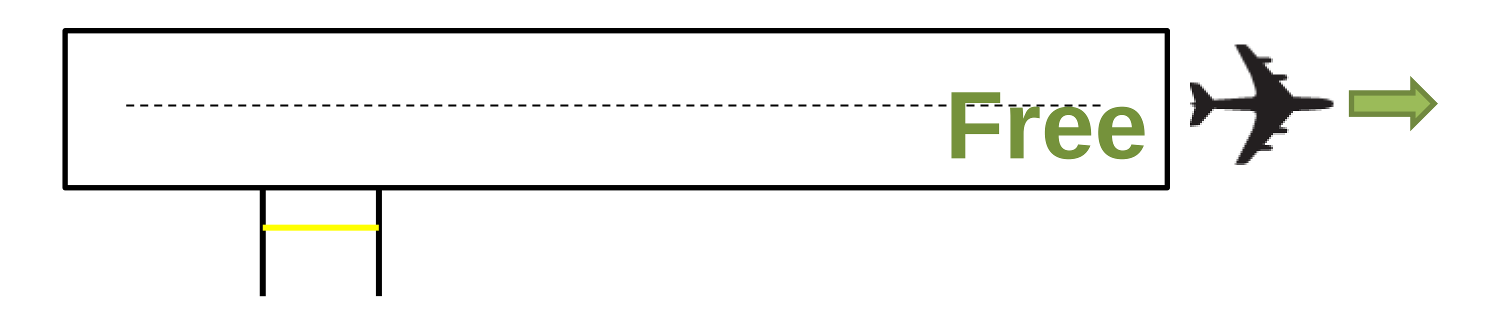
Below, an example of an aircraft which has vacated the runway:

Runway is free.



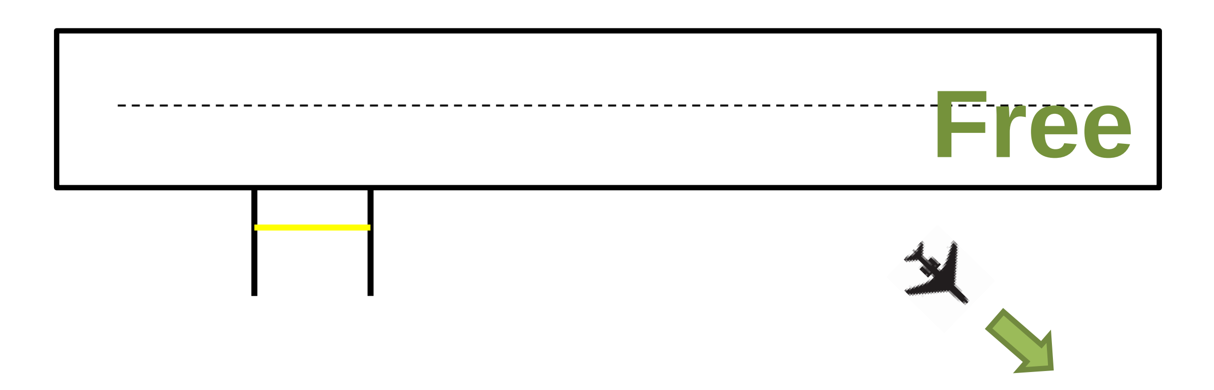
Below, an example of an aircraft which has performed its taking off and has vacated the runway after the opposite threshold:

Runway is free.



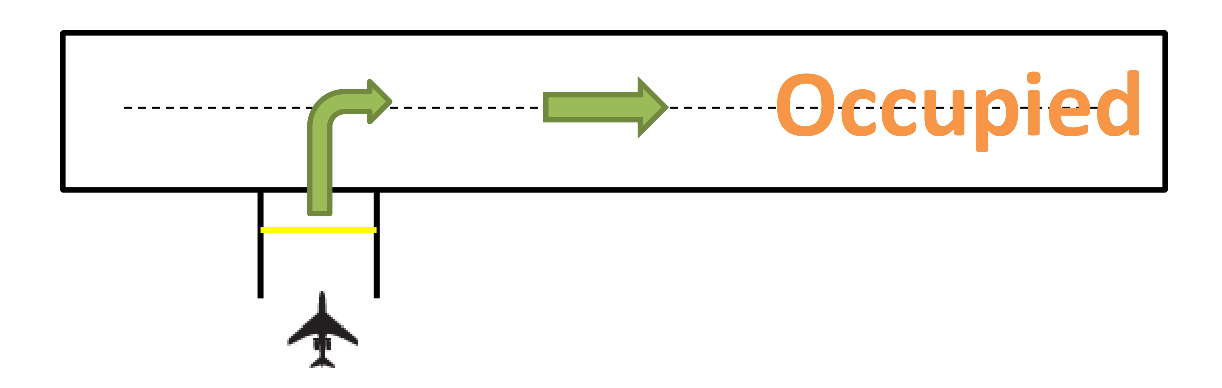
Below, an example of an aircraft which has performed its taking off and has vacated the runway with an initial turn before the opposite threshold:

Runway is free.



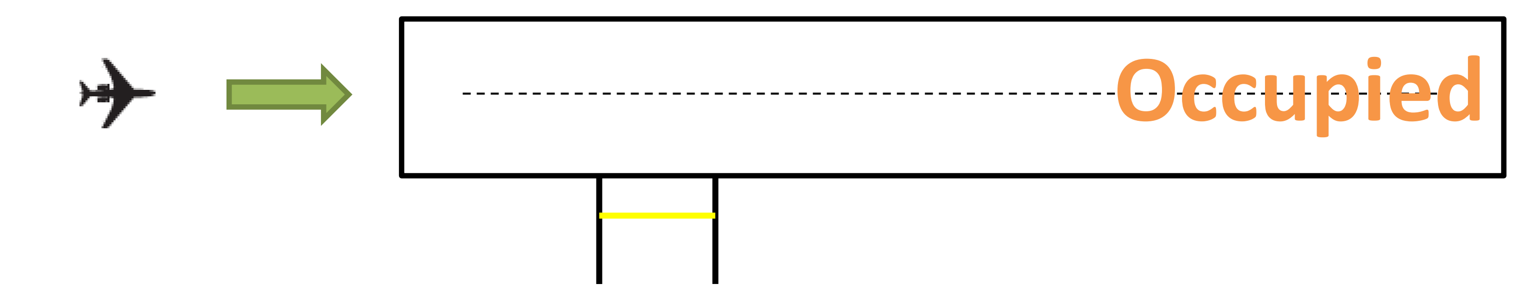
Below, an example of an aircraft behind the holding point which has received a take-off clearance or a line-up clearance:

Runway is considered as **occupied**.



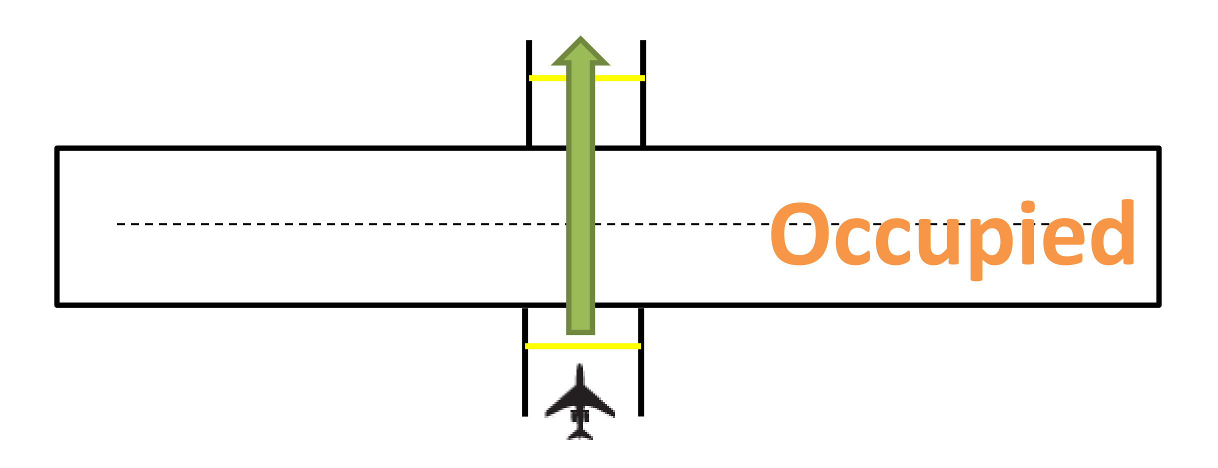
Below, an example of an aircraft flying on final, which has received a landing clearance:

Runway is considered as **occupied**.



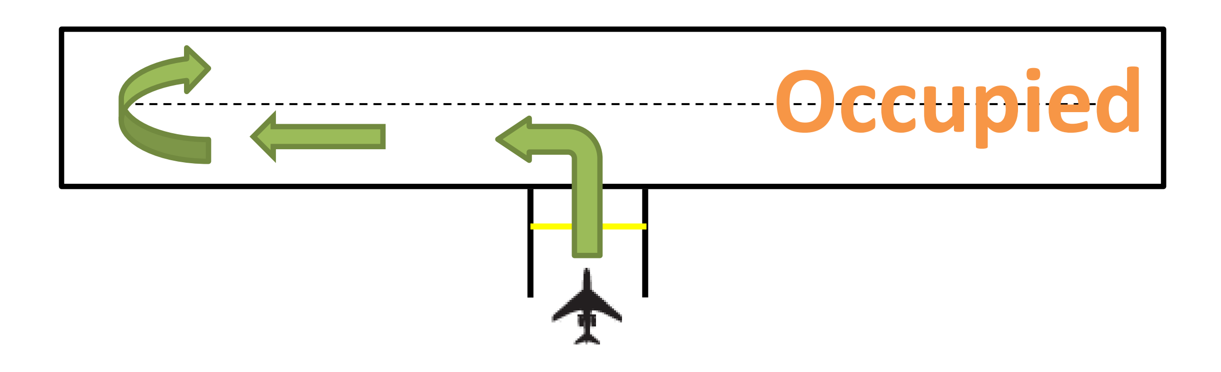
Below, an example of an aircraft which has received a crossing clearance:

Runway is considered as **occupied**.



Below, an example of an aircraft which has received a back track (back taxi) clearance:

Runway is considered as **occupied**.

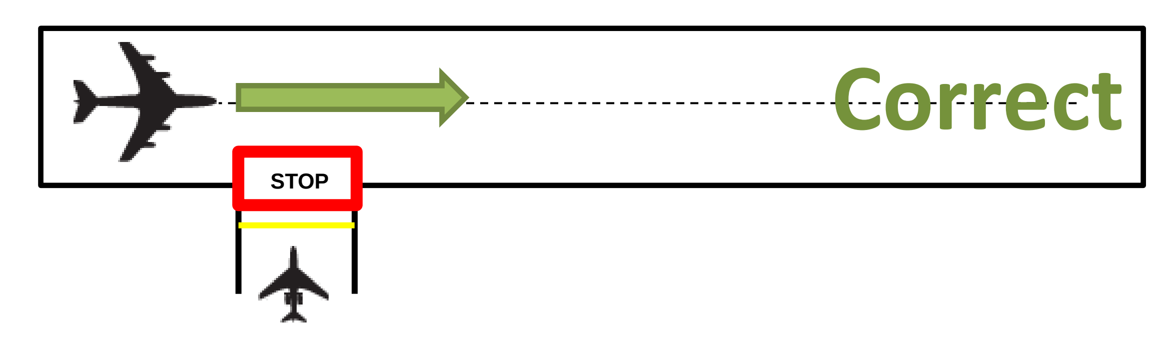


5. Situation with two aircraft in one runway

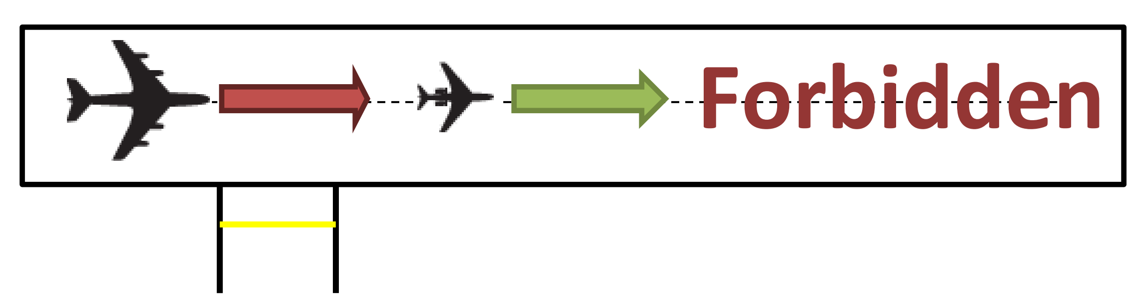
Definition: Heavy aircraft image =  Medium aircraft image =

5.1. Basic situation with a line-up, taking off or landing aircraft

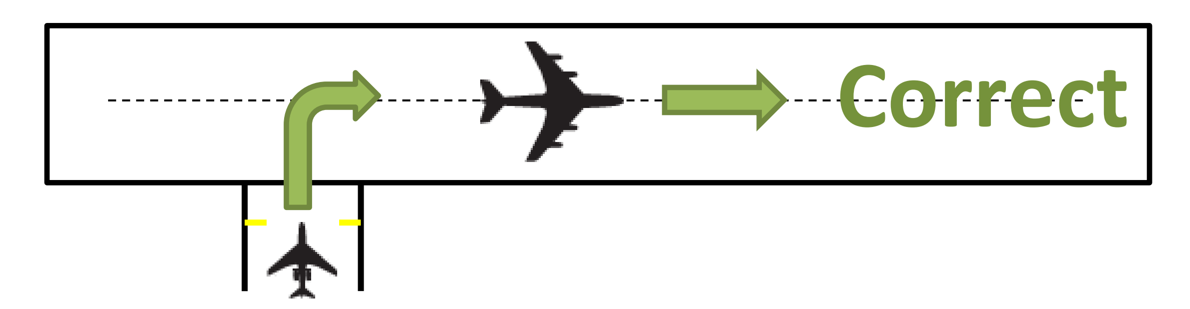
Below, the medium aircraft is holding at the holding point, ATC can give the take-off clearance to heavy aircraft and this aircraft can perform the taking-off.



Below, the medium aircraft is on the runway or overflying the runway, ATC cannot give any take-off clearance to the heavy aircraft and this aircraft cannot perform the taking-off.

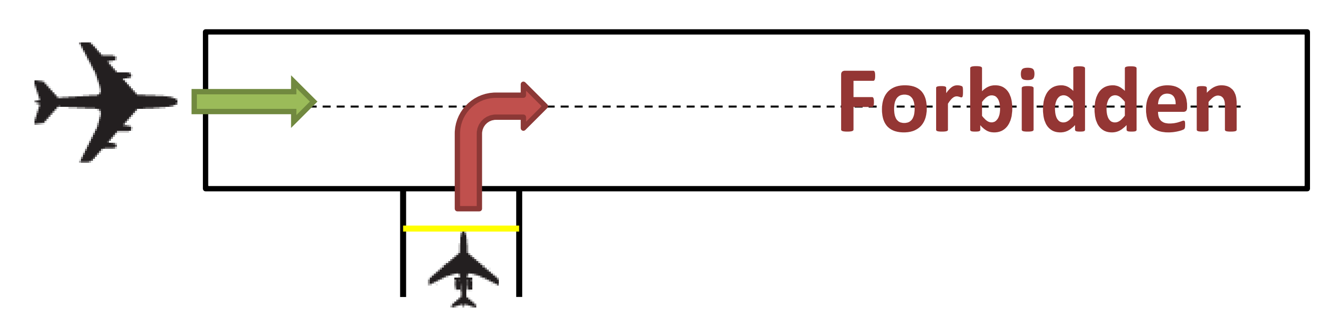


Below, the heavy aircraft is landing or taking off and has crossed the position next to the holding point occupied by the medium aircraft, ATC can give the line-up clearance to medium aircraft and this aircraft can enter the runway only for line up operation or taxiing operation via the runway.



In the situation above, if the heavy aircraft is landing, there must be another free taxiway in order to vacate the runway without any backtrack.
See backtrack operation at the end of this document to study one holding point operations.

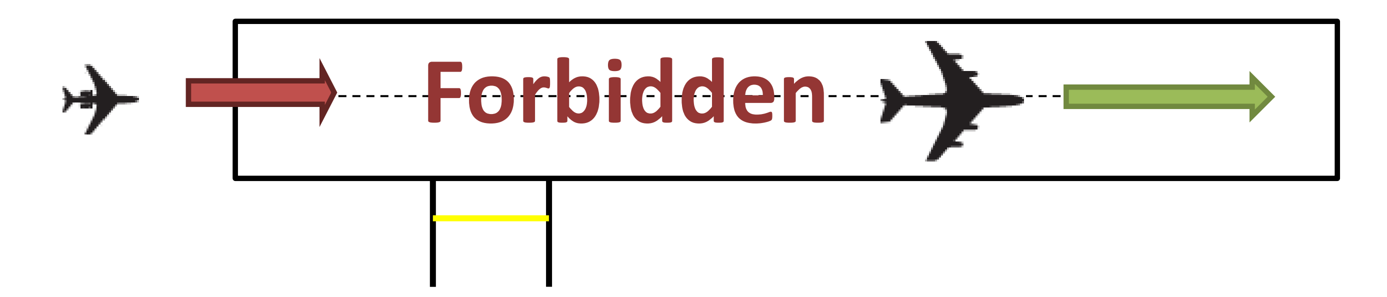
Below, the heavy aircraft is on final before the runway threshold, ATC cannot give the line-up clearance to medium aircraft and this aircraft cannot enter the runway.



In the case above, the air traffic controller can use a conditional line-up clearance to speed up the management of the runway (only possible if country and airport regulation permits conditional clearance). The controller must verify that the pilot in the aircraft at the holding point can see the incoming traffic.

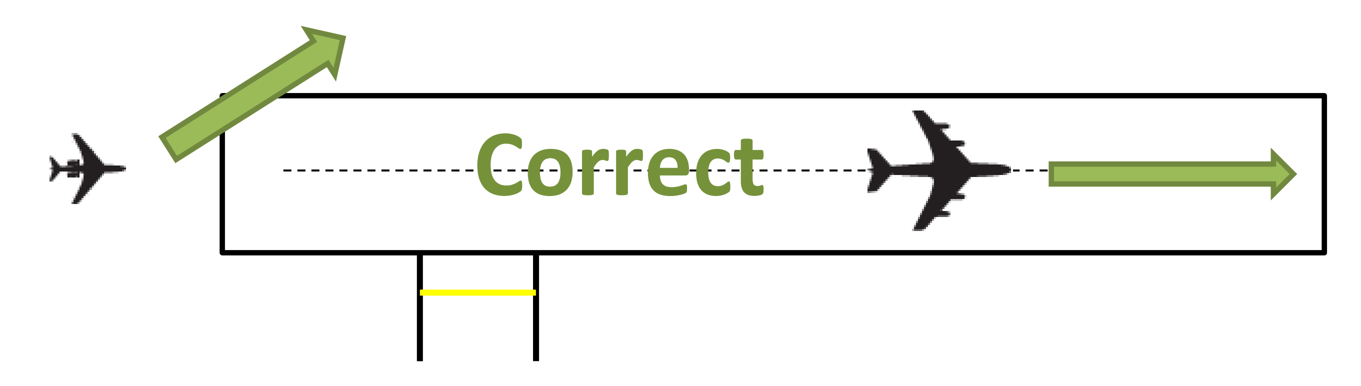
5.2. Go around operation

Below, the medium aircraft is on final before the runway threshold and a heavy aircraft is on the runway taxiing, landing or overflying, ATC cannot give the landing clearance to the medium aircraft and this aircraft cannot land on the runway until the heavy aircraft has vacated the runway.



As the pilot in command of your aircraft, if the runway is not free and your aircraft is on short final (<2NM), you must go around with no delay even if you have received a landing clearance.

As an air traffic controller, if the runway is not free and there is an aircraft on short final (<2NM), you must order a go around clearance without delay. Be aware of air traffic separation if the first aircraft will not land!



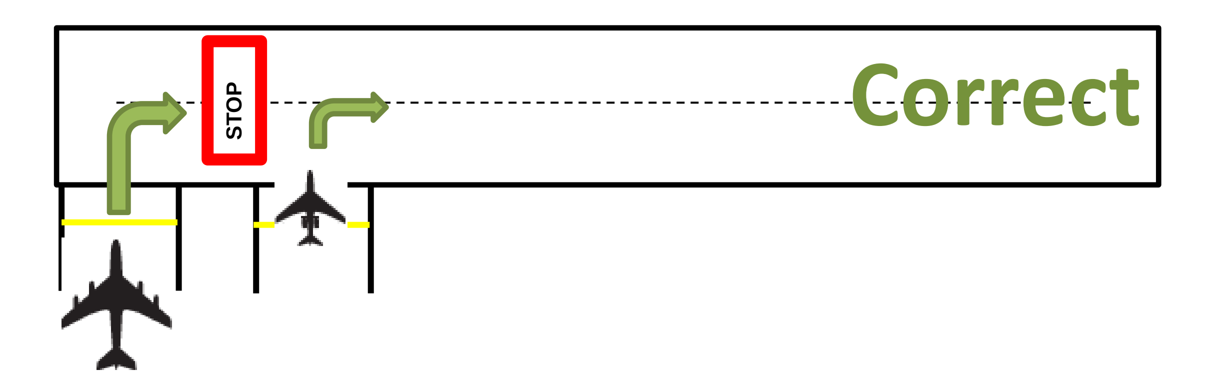
5.3. Multi alignment operation

In the largest airports, many holding points and vacating taxiways are available for each runway. These numerous holding points and taxiways are sometimes necessary to provide enough opportunities to the pilots to choose the best and quickest taxiway to vacate the runway.

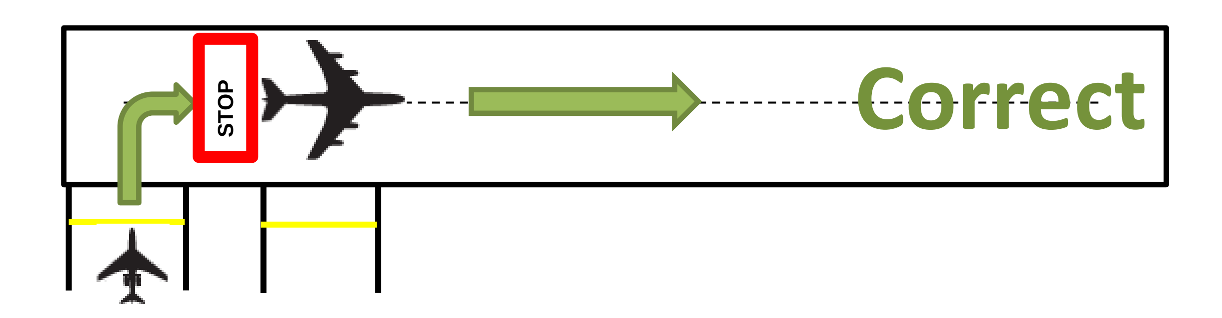
As an air traffic controller, you can use these numerous taxiways and holding points for:

- Making homogeneous departure sequence
- Using multi alignment procedure
- Expediting light aircraft departure

Below, this is an example of multi-alignment operation. Both aircraft have received a line-up procedure. As air traffic controller advise the aircraft behind (here the heavy one) about traffic in front of him from another taxiway.

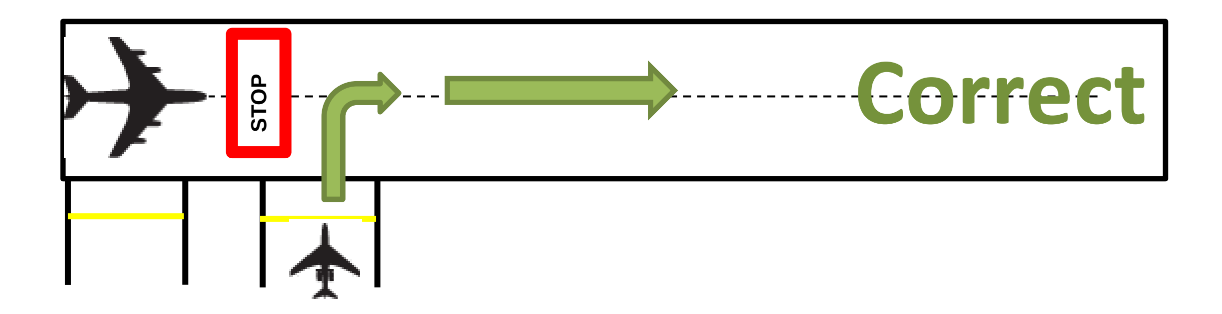


Below, the medium aircraft is holding position on the runway behind the heavy aircraft, ATC can give the take-off clearance to the heavy aircraft and this aircraft can perform the taking-off. The medium aircraft shall maintain his position until the heavy aircraft has vacated the runway.



Note that multi-alignment from different taxiways behind a taking off aircraft is authorized in order to optimize the taking off sequence.

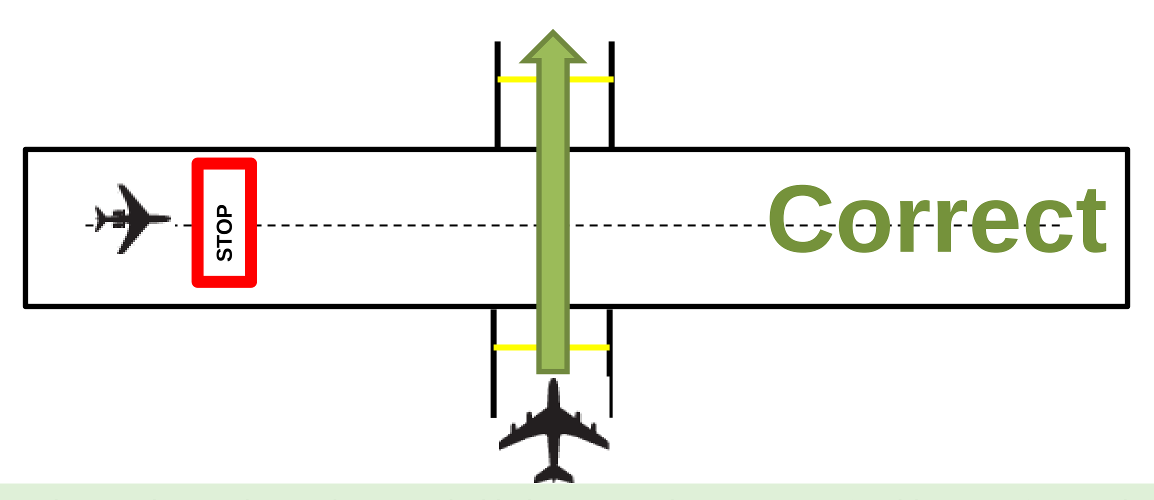
Below, the heavy aircraft is holding position on the runway behind the medium aircraft lining up, ATC can give the take-off clearance to the medium aircraft and this aircraft can perform the taking-off. This situation can be used by the air traffic controller to expedite a light aircraft departure before a take-off of an heavier aircraft.



5.4. Runway crossing operation

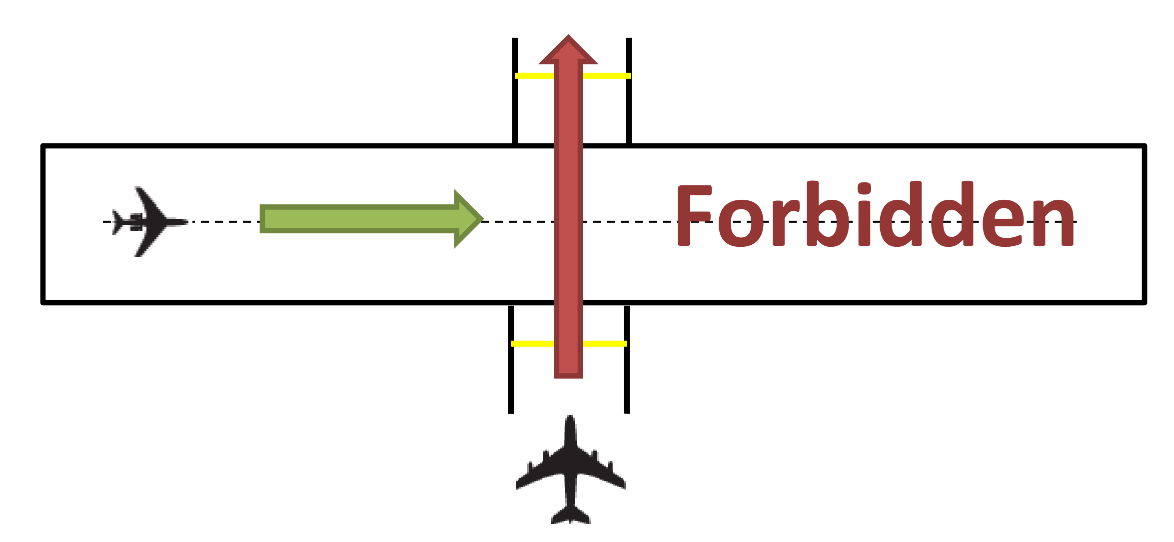
In some airfields, a runway crossing clearance is needed in order to let aircraft join an apron area, or a holding point. The runway crossing operation can be used in the same way like multi alignment operation.

Below, the medium aircraft is holding position on the runway and the heavy aircraft needs to cross the runway, ATC can give the crossing clearance to the heavy aircraft and this aircraft can perform the taxi. The medium aircraft shall maintain position and must not perform any take-off operation.



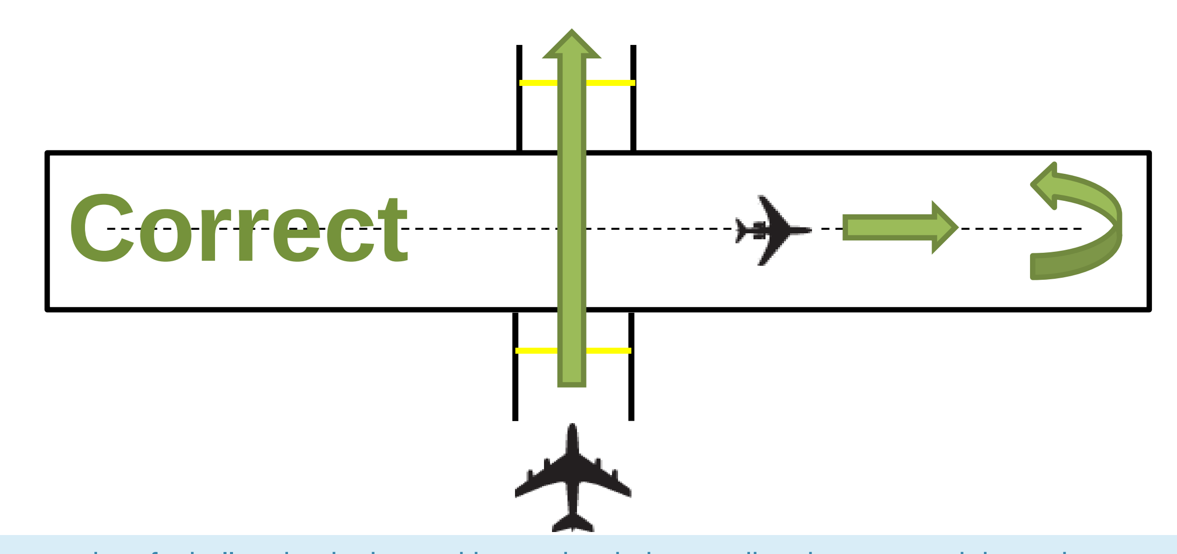
A runway can be used as taxiway when needed if the runway is free to use for this type of operation.

Below, the medium aircraft is moving on the runway (taxiing, landing, taking off or overflying) and the heavy aircraft needs to cross the runway, <u>ATC cannot give the crossing clearance to the heavy aircraft</u> and <u>this aircraft must hold at the holding point. The medium aircraft shall finish its procedure.</u>



Note that a conditional crossing clearance behind a taking off or a landing aircraft should not be used for safety reasons.

Below, the medium aircraft has vacated the crossing taxiways after a landing, taking off or taxiing operation and the heavy aircraft need to cross the runway, <u>ATC can give the crossing clearance to the heavy aircraft</u> and <u>this aircraft can perform the taxi.</u>

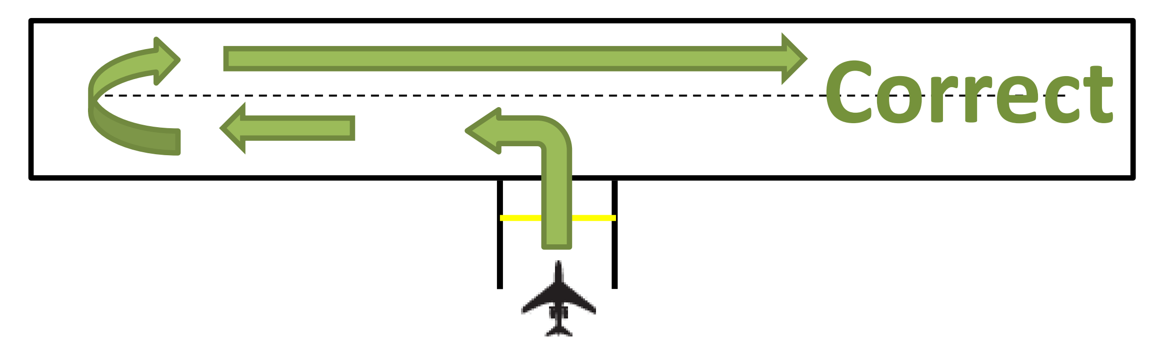


The heavy aircraft shall maintain the position and wait that medium has crossed the taxiway.

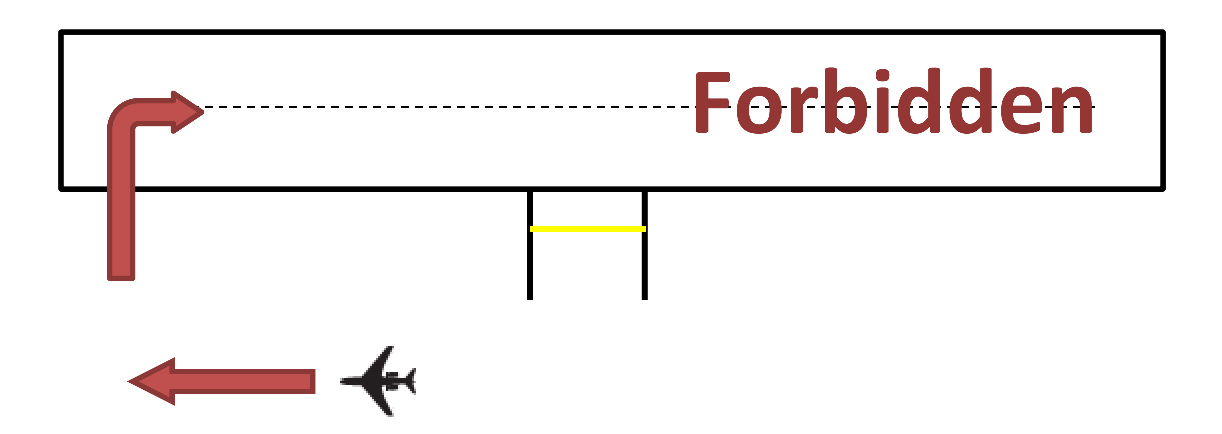
5.5. Runway back-track operation

Some small airfields have few holding points and taxiways to exit and enter the runway.
Sometimes the holding point is not located at the runway threshold. In that case, you must use the runway as taxiway in order to line up at the beginning of the runway. This taxi operation is called "back-track" (or back taxi in some countries).

Below, the medium aircraft is at the unique holding point of the runway, and the air traffic controller gives the take-off clearance but the aircraft needs the whole runway to take off, then ATC shall give a back-track clearance to the aircraft, followed by the take-off clearance.



Some IVAO beginners sometimes take the opportunity to taxi via the grass outside any taxiway and apron: this is a wrong operation if one taxiway exists.

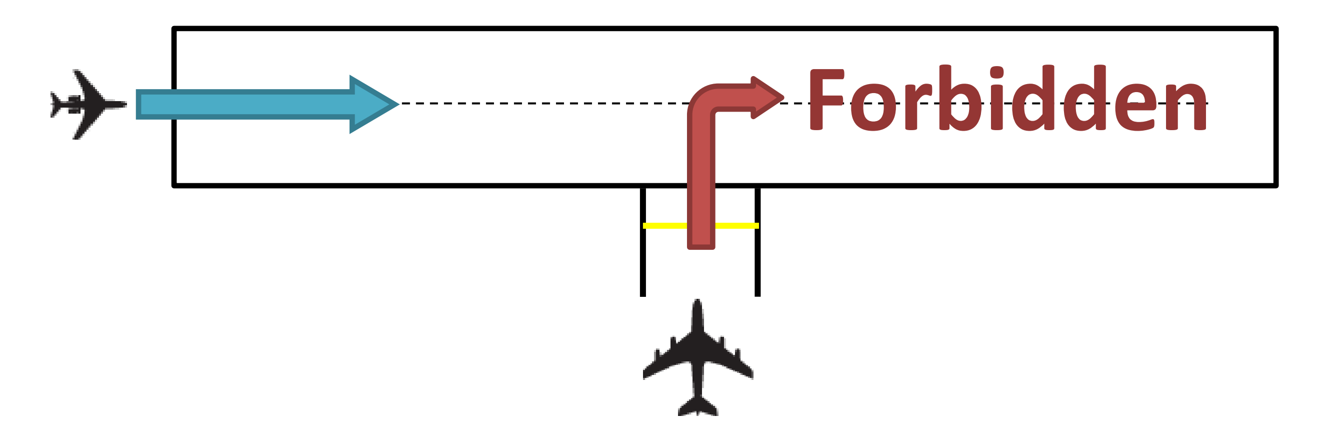


The aircraft shall not leave the taxiway or runway in order to join the runway threshold.

For an airfield with only one taxiway at the middle, and with two aircraft involved with the situation. The air traffic controller has already given a taxi clearance to a heavy aircraft to the unique holding point.

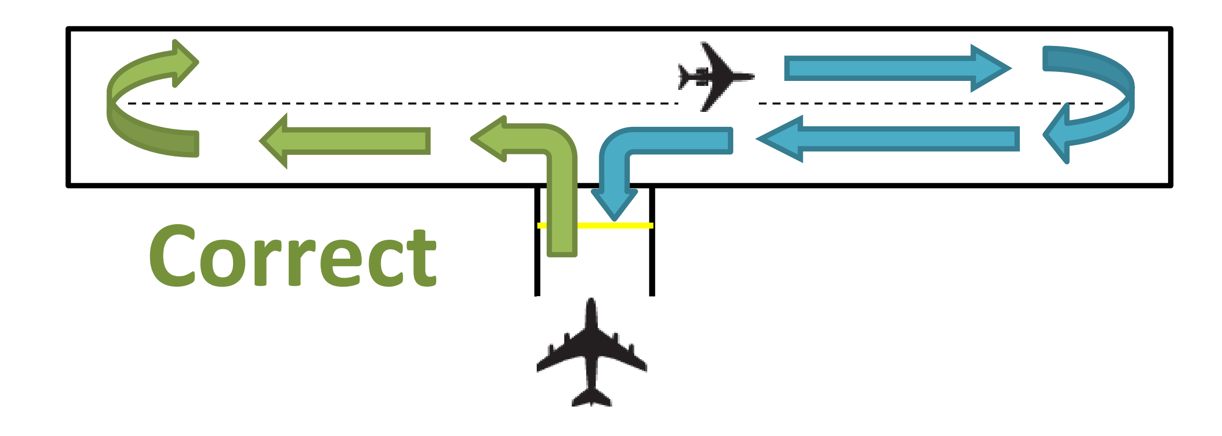
Below, the heavy aircraft is at the unique holding point of the runway, and the air traffic controller needs to give the take-off clearance but there is a medium aircraft on final which is currently landing.

The problem is that the heavy aircraft occupies the unique vacating taxiway and the landing medium aircraft will occupy the runway and cancel the take-off.



A simple solution is to use double back-track operation in order to avoid a go-around procedure of the medium aircraft:

- The solution is to give a clearance to the medium aircraft to continue to the end of the runway after landing, in order to let the heavy aircraft back-track to the beginning of the runway.
- Continuing this back-tracking procedure, the heavy aircraft will allow the holding point to be free for use by the medium aircraft.
- The medium aircraft will perform a back-track operation after a half turn and vacate the runway using the unique taxiway while the heavy aircraft will wait at the runway threshold. Then, the heavy aircraft can initiate the taking off without risk.





SELECT THE RUNWAY IN USE

1. Introduction

The term "runway-in-use" shall be used to indicate the runway or runways that are considered by the aerodrome control tower to be the most suitable for use by the types of aircraft expected to land or take-off at the aerodrome.

This documentation is made to help air traffic controllers and pilots in non-controlled areas to select the best runway for landing and taking-off.

1.1. Data source

Before any decision, you must have:

- All aeronautics charts of your airfield VFR, IFR (IAC, ARR, DEP…)
- Last METAR of the selected airfield or nearest airfield (if not available for the selected airfield)
- Last TAF of the selected airfield if existing

1.2. What do the documents tell

Sometimes constraints are published on charts. You must read all the charts and take these constraints into account:

- Preferred landing runway
- Preferred take-off runway (especially if different than to the landing runway)
- Preferred runway to open under special circumstances (night, heavy, low visibility, noise)
- Runway with or without precision approach procedure (like ILS approach)
- Runway with or without non-precision approach procedure (like VOR, NDB approach)
- Landing minima (weather)

Be aware that sometimes there are local recommendations known by pilots and/or air traffic controllers but not written on charts. These can be applicable if the current traffic flow permits them.

Pay attention that the selection of any real configuration (take-off and landing runways) in IVAO without considering constraints and traffic can be a wrong choice.

Be aware that the IVAO weather is based on the last upload of the METAR information. Sometimes IVAO can have outdated weather information. Do not synchronize with the real time weather; compare the METAR information you have got.

2. Runway selection criteria

We start to study the different criteria. The most important parameter to take into account is the wind.

2.1. Wind direction

An aircraft lands and takes-off into the wind. Reason being that headwind creates lift.



The wind near the runway is given by the METAR information. The wind group is 5 digits ending with KT or MPS:

- First 3 digits represent the heading of the aircraft which has the wind in front of him
- Last 2 digits represent the wind speed
- KT or MPS is the unit of the wind speed: KT =knot; MPS =meter per second.

Example:
METAR 262100Z **27007KT** CAVOK 08/03 Q1023 NOSIG
The winds come from 270°, speed is 7 knots.

If the wind speed is lower than 5knots, the wind can be considered not important as a selection criteria.

2.2. Weather minima

METAR information also gives visibility and ceiling information.

You must check the compatibility of the ceiling and the IFR approach minima given by the charts.

Ceiling in METAR is the lowest group BKN or OVC followed by 3 digits. The 3 digits are the height in hundreds of feet of the cloud base level.

Example:
METAR 262100Z 27007KT 8000 **FEW005 OVC012 BKN044 FEW095** 08/03 Q1023 NOSIG
Ceiling is the group OVC012 (the lowest group with OVC or BKN)
Height = 012 * 100 = 1200 ft

2.3. Published runway use recommendation

Sometimes, in some airfields, the runway in use recommendation is published.

You need to apply the chart recommendation where possible (wind compatible, weather minima …).

The runway recommendation criteria can be:

- Preferential runway (general)
- Preferential runway during night operation
- Preferential runway due to ground landmark or obstacle
- Preferential runway for noise reduction procedure
- Preferential runway due to activation or presence of restricted areas
- Preferential runway due to dual runway available
- Specialized runway within a doublet runway
- Specialized runway dedicated for landing
- Specialized runway dedicated for take-off
- Runway restriction for a specific aircraft category (A,B,C,D)

Runways should not be selected for noise abatement purposes for landing operations unless they are equipped with suitable glide path guidance or a visual approach slope indicator system for operations in VMC.

Noise abatement shall not be a determining factor in runway nomination if the runway surface conditions are adversely affected, when the ceiling is lower than 500ft, visibility is less than 1900m, crosswind exceeds 15KT, or tailwind component including gusts exceeds 5KT.

2.4. IFR published approach on runway available

At some airfields, there is no IFR approach published for one or several runways, or an IFR approach is published only for one side of a runway.

We recommend to select a least one active runway with an IFR approach published when the wind favours this selection.

In case of selection of a runway with no published IFR approach procedure, an aircraft shall select an IFR approach on another runway then perform a visual approach to the selected runway when reaching the aerodrome circuit altitude or the IFR approach minima and if the pilot has visual on the selected runway.

2.5. Preliminary criteria to check

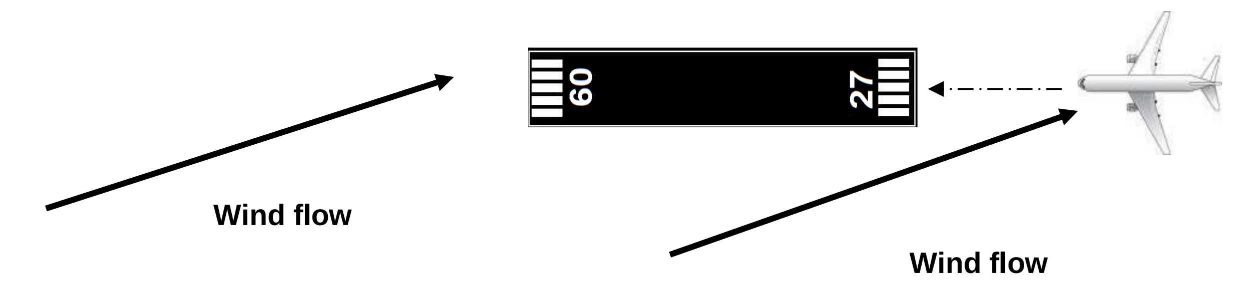
You must check:

- Approach aircraft category must be compatible with the charts publication
- Runway is not closed on charts (or NOTAM when applicable)
- No land mark obstacles are present

NOTAM application is possible and can imply the closure of a runway:
Be aware that the application of real world NOTAMs is not mandatory in IVAO. NOTAM application is optional. Please consider NOTAM application for daily use in IVAO in relation to the realism of the network and the beginners' management.

2.6. Headwind, tailwind and crosswind calculation

The wind flow does not follow the runway axis all the time. It often comes from the left or the right.

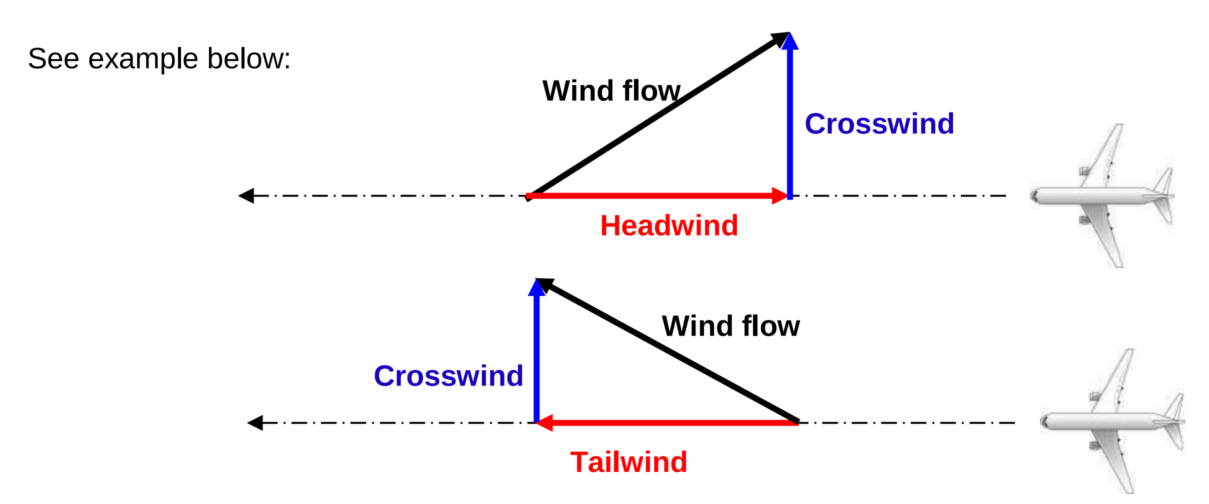


The wind flow can be taken from the METAR information (see chapter §2.1).

There are 2 parts in a wind flow:

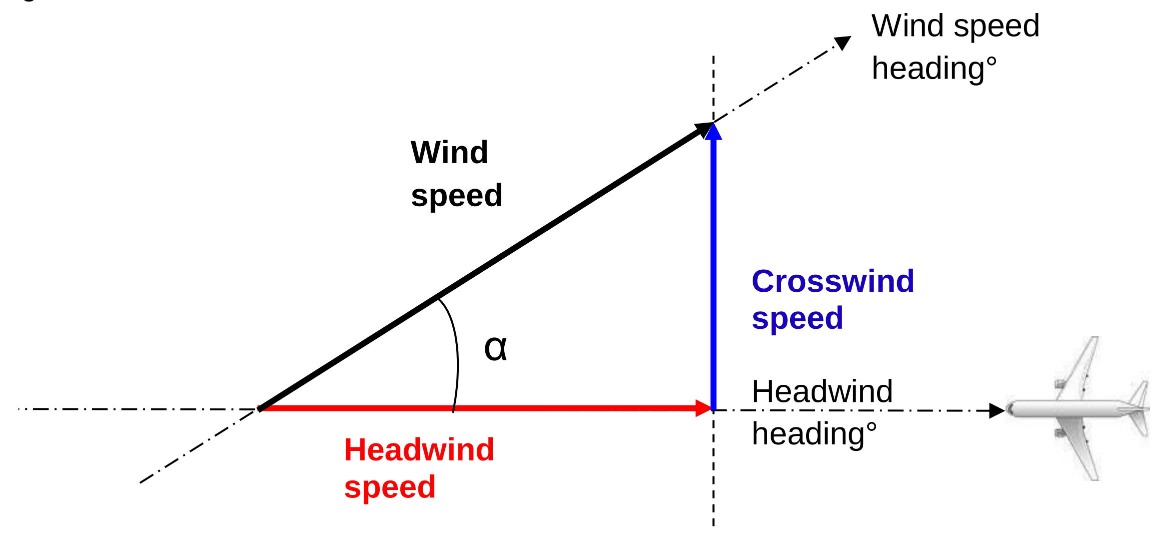
- a headwind blows against the direction of travel or a tailwind blows in the same direction of travel
- a cross wind blows using perpendicular direction of travel (from the left or from the right)

See example below:



2.6.1. Headwind configuration

α is the angle of the wind from direction of travel.



α = (Wind speed heading° - Headwind Heading°)

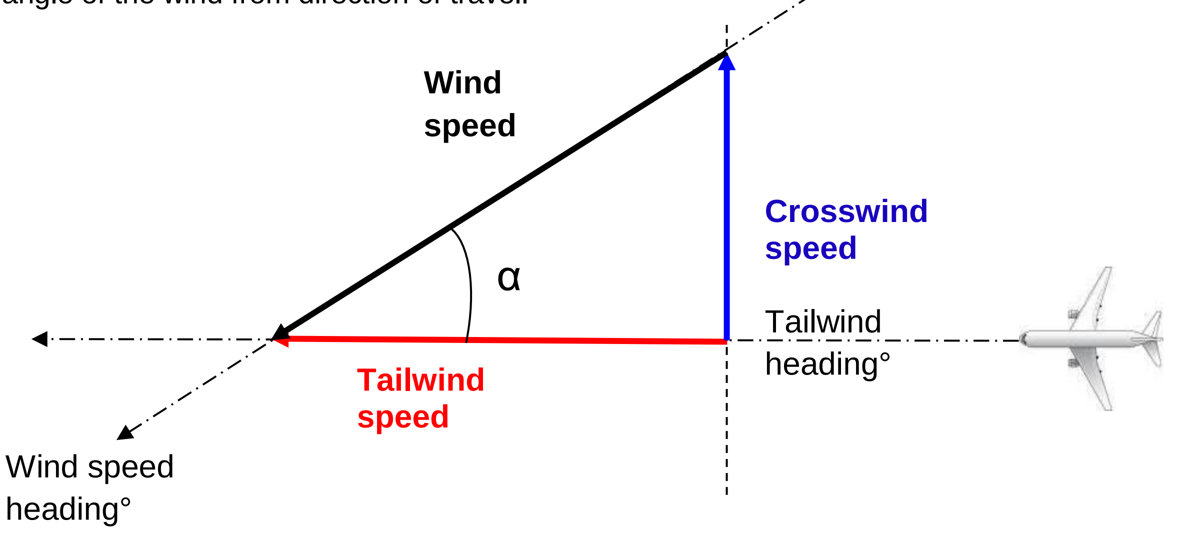
Headwind heading = Aircraft heading

The angle shall be: -90° < α < +90°

Note that METAR heading of the wind is the heading of the aircraft which has the wind in front of him

2.6.2. Tailwind configuration

α is the angle of the wind from direction of travel.



α = (Wind speed heading° - Tailwind Heading°)

Tailwind heading = Aircraft heading ± 180°

The angle shall be: -90° < α < +90°

2.6.3. Calculation

We now calculate the crosswind and headwind (tailwind) speeds using the angle α and METAR information:

Crosswind speed = wind speed * sin (α)

Headwind speed (or tailwind) = wind speed * cos (α)

As the 'sine' and 'cosine' mathematical functions are quite complex, here are some conversion tables:

This table below is the conversion of 'sine' and 'cosine' functions:

α	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
sin α	0	0.17	0.34	0.5	0.64	0.77	0.86	0.94	0.98	1
cos α	1	0.98	0.94	0.86	0.77	0.64	0.5	0.34	0.17	0

We can have a simpler table for wind calculation: here we have approximated crosswind and headwind speeds for a wind speed value = 10.

A	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
Crosswind	0	0	3	5	6	7	8	9	10	10
Headwind (tail)	10	10	9	8	7	6	5	3	0	0

Example:
Wind speed = 8KT
Aircraft heading = 60°
Wind speed heading in METAR = 100°

We are in headwind configuration, so: Headwind = Aircraft heading° = 60°.
α = 100° - 60° = 40°
True calculation: Crosswind = 8 * sin(40°) = 5.14 KT ; Headwind = 8 * cos(40°) = 6.12 KT
First table calculation: Crosswind = 8 * 0.64 = 5.12 KT ; Headwind = 8 * 0.77 = 6.16 KT : error < 1%
Second table calculation: Crosswind = 8 * 6/10 =4.8 KT ; Headwind = 8 * 7/10 = 5.6 KT ; error < 10%

Tailwind and Crosswind values are different for each runway!

For runway 24, if the headwind is +5KT, then for opposite runway 06, the headwind is transformed into a tailwind. So, for the runway 06, Headwind is -5KT or tailwind is +5KT.

3. How to select runway : method

3.1. Selection order for a runway

The selection order to choose a runway outside any weather parameter is:

1. Select a published preferred IFR runway or usual runway known as a real usage
2. Select a runway with precision IFR approach (like ILS)
3. Select a runway with one non-precision IFR approach at least
4. Other runway with visual approach minima published for IFR flights

Be aware that in IVAO, the weather condition should be good enough in order to let the pilots perform an approach safety.
If the visibility and ceiling conditions are too low, we recommend selecting a runway with a precision approach available (like ILS). If you do not have a precision approach, select the runway with an IFR approach with the lowest minima. If the wind speed is high, we recommend selecting the runways with headwind.

3.2. Use of the published IFR runway (or usual runway)

If a preferred runway is published or, if it is a runway usually used in real aviation, this runway can be selected as the main landing runway. The table below can help you to decide if you can choose this runway.

Published preferred IFR runway					
Ceiling is	Compatible with minimum one published IFR approach	Compatible with minimum one published IFR approach	Compatible with minimum one published IFR approach	Compatible with minimum one published IFR approach	Not compatible with any IFR approach
Wind direction is	Headwind > 0 KT or wind = 0 KT	Tailwind < 6 KT	6 KT< Tailwind <15 KT	Tailwind >15 KT	All winds configuration
Can this runway be opened?	Yes	Possible	ATC Analysis	No	No

Notes:
Yes: means that this runway can be opened with no restrictions for IFR.
Possible: means that this runway can be opened with no ceiling restriction but with presence of light tailwind for the pilot.
ATC Analysis: means that an analysis must be done by ATC to check if another runway can be selected or not according to the current weather and chart publications.
No: means that this runway cannot be selected and is not usable with present conditions; check other chapters in order to select your runway configuration in function of IFR approach types.

In case of selection of a runway with tailwind, the pilot-in-command shall be informed about the wind configuration when:

- Tailwind is greater than 6 KT for Light aircraft category
- Tailwind is greater than 8 KT for Medium and Heavy aircraft category

3.3. Use of runway with an IFR precision approach (ILS type)

If one runway has a precision approach published (example ILS), this runway can be selected as the main landing runway. The table below can help you to decide if you can choose this runway.

Published preferred runway					
Ceiling is	Compatible with precision approach minima	Compatible with precision approach minima	Compatible with precision approach minima	Compatible with precision approach minima	Not compatible with precision approach minima
Wind direction is	Headwind > 0 KT or wind = 0 KT	Tailwind < 6 KT	6 KT< Tailwind <15 KT	Tailwind >15 KT	All winds configuration
Can this runway be opened?	Yes	Possible	ATC Analysis	No	No

Notes:
Yes: means that this runway can be opened with no restrictions for IFR.
Possible: means that this runway can be opened with no ceiling restriction but with presence of light tailwind for the pilot.
ATC Analysis: means that an analysis must be done by ATC to check if another runway can be selected or not according to the current weather and chart publications.
No: means that this runway cannot be selected and is not usable with present conditions.

The precision approach minima are the lowest minima required in real aviation. If the precision approach minima are not available, you can be sure that your airfield is closed for traffic.

In case of selection of a runway with tailwind, the pilot-in-command shall be informed about the wind configuration when:

- Tailwind is greater than 6 KT for Light aircraft category
- Tailwind is greater than 8 KT for Medium and Heavy aircraft category

3.4. Use of runway with a non-precision IFR approach

A classical approach can be a VOR, NDB, RNAV non-precision approach. The table below can help you to decide if you can choose this runway.

Non-precision IFR approach runway					
Ceiling is	Compatible with one IFR approach minima	Compatible with one IFR approach minima	Compatible with one IFR approach minima	Compatible with one IFR approach minima	Not compatible with one IFR approach minima
Wind direction is	Headwind > 0 KT or wind = 0 KT	Tailwind < 6 KT	6 KT< Tailwind <15 KT	Tailwind >15 KT	All winds configuration
Can this runway be opened?	Yes	Possible	ATC Analysis	No	No

Notes:
Yes: means that this runway can be opened with no restrictions for IFR.
Possible: means that this runway can be opened with no ceiling restriction but with presence of light tailwind for the pilot.
ATC Analysis: means an analysis must be done by ATC to check if another runway can be selected or not according to the current weather and chart publications.
No: means that this runway cannot be selected and is not usable with present conditions.

If the non-precision minima are not available and if your airfield has no IFR precision approach, you can be sure that your airfield is closed for traffic.

In case of selection of a runway with tailwind, the pilot-in-command shall be informed about the wind configuration when:

- Tailwind is greater than 6 KT for Light aircraft category
- Tailwind is greater than 8 KT for Medium and Heavy aircraft category

3.5. Use of runway with visual approach

If you select a runway with only visual approach with or without prescribed tracks, the pilot shall perform an IFR approach using another runway before switching to a visual approach of the selected runway at the minima or at the aerodrome circuit altitude. The table below can help you to decide if you can choose this runway.

Published preferred runway					
Ceiling is	Compatible with Visual approach minima	Compatible with Visual approach minima	Compatible with Visual approach minima	Compatible with Visual approach minima	Not compatible with Visual approach minima
Wind direction is	Headwind > 0 KT or wind = 0 KT	Tailwind < 6 KT	6 KT< Tailwind <15 KT	Tailwind >15 KT	All winds configuration
Can this runway be opened?	Yes	Possible	Disadvantageous	No	No

Notes:
Yes: means that this runway can be opened with no restrictions for IFR.
Possible: means that this runway can be opened with no ceiling restriction but with presence of light tailwind for the pilot.
Disadvantageous: means that configuration is not really good for incoming aircraft. If you have a better solution, use it!
No: means that this runway cannot be selected and is not usable with present conditions.

Be aware that selecting a visual approach, the weather condition shall be good enough in order to perform a safe approach on your airfield. Choose when possible a runway with a minimum of one IFR approach available.

3.6. VFR only airfield

We are in the case of a VFR airfield only. These tables below can help you to decide if you can choose this runway.

VFR runway under VMC				
Ceiling is Visibility is	> 1500 ft > 5000 m	> 1500 ft > 5000 m	> 1500 ft > 5000 m	> 1500 ft > 5000 m
Wind direction is	Headwind > 0 KT or wind = 0 KT	Tailwind < 6 KT	6 KT< Tailwind <15 KT	Tailwind >15 KT
Can this runway be opened?	Yes	Possible	Disadvantageous	No

3.7. Special VFR conditions

The table below is applicable <u>if your national regulations allow special VFR clearances</u>. The minima of ceiling or visibility can be different with regards to your national regulations. The values given are typical.

VFR runway below VMC				
Ceiling is Visibility is	1500ft > C > 1000ft 5000m > V > 1500m	1500ft > C > 1000ft 5000m > V > 1500m	1500ft > C > 1000ft 5000m > V > 1500m	1500ft > C > 1000ft 5000m > V > 1500m
Wind direction is	Headwind > 0 KT or wind = 0 KT	Tailwind < 6 KT	6 KT< Tailwind <15 KT	Tailwind >15 KT
Can this runway be opened?	Yes Special VFR only	Possible Special VFR only	Disadvantageous Special VFR only	No
	No If Special VFR not allowed	No If Special VFR not allowed	No If Special VFR not allowed	No

VFR runway under low visibility in IMC				
Visibility is	< 1500 m	< 1500 m	< 1500 m	< 1500 m
Wind direction is	Headwind > 0 KT or wind = 0 KT	Tailwind < 6 KT	6 KT< Tailwind <15 KT	Tailwind >15 KT
Can this runway be opened?	No	No	No	No

Pay attention that some countries can allow helicopter VFR flight under 1500m. Please check your national regulations.



TRAFFIC INFORMATION

1. Introduction

Traffic information is information issued to advice pilots of known or observed traffic, which may be in such proximity to their position or intended route of flight to warrant their attention.

2. Radar traffic information

The radar traffic information is applicable in IVAO for the following positions:

- CTR – en-route controller
- APP – arrival or approach controller
- DEP – departure controller
- TWR – tower controller if your position can give air traffic control service

2.1. Source of information

Traffic information may be based on:

- Visual observation
- Observation of radar identified targets
- Reports from pilots or other ATS facilities.

In IVAO, we have 3 cases:

- Radar identified targets when using the IvAc radar screen (main information in IVAO)
- Visual observation when using IvAi and your flight simulator with a tower view
- Reports from pilots or other ATS facilities when any problems occur during a server crash. Information can be obtained via radio communication with pilots or coordination in text mode with other controllers.

2.2. Application

An ATC unit shall issue position information and traffic information, as necessary, to assist aircraft in establishing visual separation from other aircraft.
An ATC unit shall also issue traffic information on an aircraft's request.

An ATC unit shall provide traffic information to:

- VFR aircraft in Class C and D airspace
- VFR aircraft in Class E airspace if workload permits
- Radar-identified IFR aircraft if the targets appear likely to merge with another radar-observed target

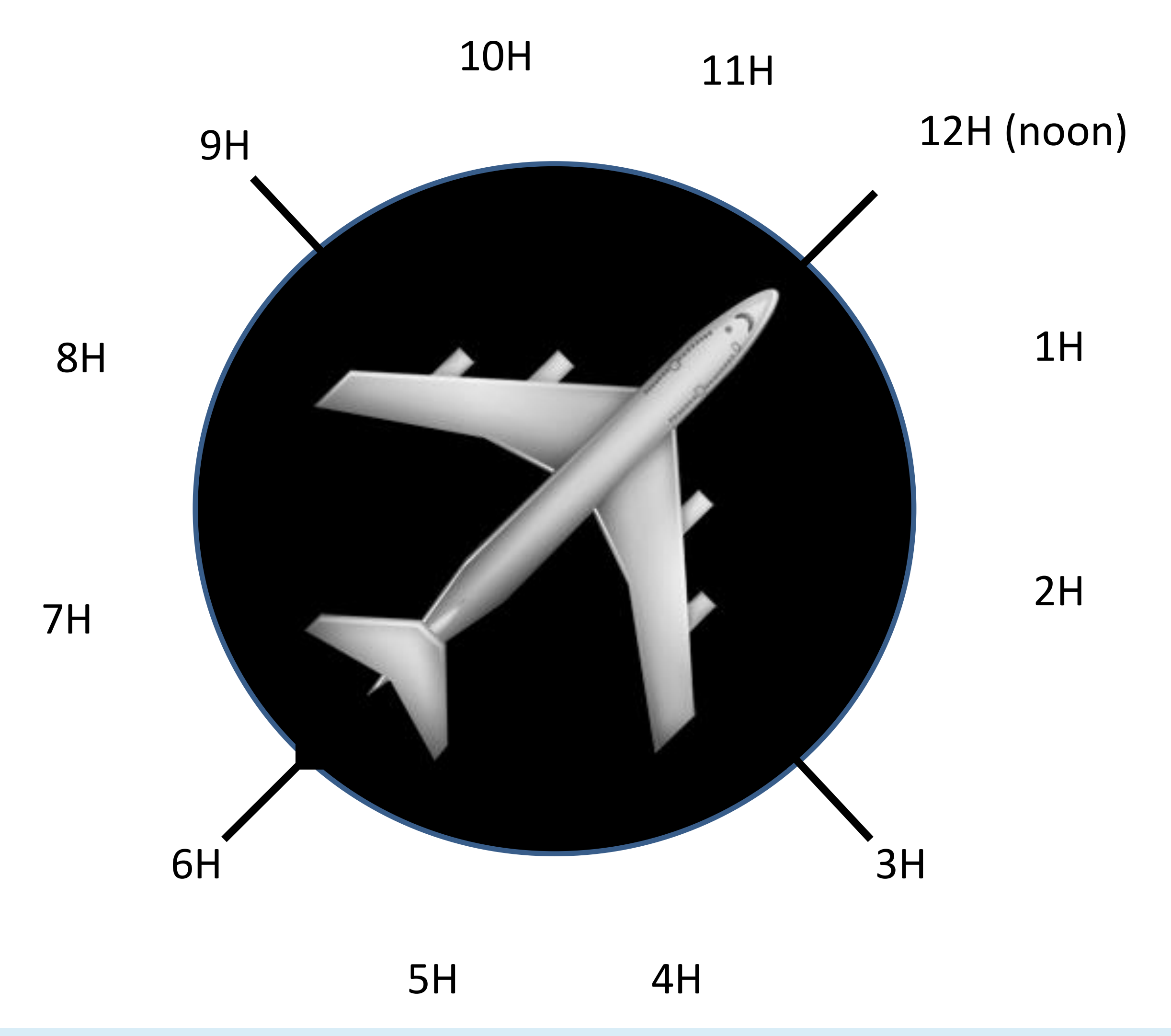
Provision of this service is mandatory unless precluded by higher priority duties. In Class E airspace, traffic information to VFR is provided on a workload permitting basis.

You need not provide traffic information when traffic is:

- Known to be separated by more than the appropriate vertical separation minimum
- Established in a holding pattern by more than the appropriate vertical separation minimum

2.3. Relative position

Any air traffic controller can use the relative position of the traffic in terms of the 12-hour clock in relation to the aircraft.



Example:
TRAFFIC 11 O'CLOCK, 10 MILES, SOUTHBOUND, B737, FLIGHT LEVEL 230.

2.4. Elements to transmit and phraseology

If issuing radar-observed traffic information to an aircraft that is radar identified, include the following items:

- the **position** of the traffic in terms of the 12-hour clock in relation to the aircraft
- the **direction** in which the traffic is proceeding
- the **aircraft type** if known, or the relative speed
- the **altitude** if known. The altitude may be described as (number of feet) above or below.

Example:
TRAFFIC 11 O'CLOCK, 10 MILES, SOUTHBOUND, B737, FLIGHT LEVEL 230.
TRAFFIC 1 O'CLOCK, 5 MILES, WESTBOUND, SLOW MOVING, TYPE AND ALTITUDE UNKNOWN.
TRAFFIC 2 O'CLOCK, 3 MILES, FROM LEFT TO RIGHT, CESSNA 172, 2500 FEET
TRAFFIC 3 O'CLOCK, 1MILES, ON DOWNWIND RUNWAY 03, PIPER PA32, 500 FEET ABOVE

If issuing radar-observed traffic information to an aircraft that is not radar-identified, include the following items:

- the **position** of the traffic in relation to a fix;
- the **direction** in which the traffic is proceeding;
- the aircraft **type** if known, or the relative speed; and
- the **altitude**, if known. The altitude may be described as (number of feet) above or below.

Example:
TRAFFIC, 15 MILES WEST OF SYDNEY VOR, EASTBOUND, TYPE UNKNOWN, SLOW MOVING, FIVE THOUSAND FIVE HUNDRED.

Altitude data, even when not validated, may help the receiving pilot to locate the traffic

You may use other elements to provide altitude information, by stating:

- the altitude readout value;
- the word "unverified" following the altitude, if you have not validated the readout.
- the word "climbing" or "descending", if applicable.

Example:
TRAFFIC, 12 O'OCLOCK, ALTITUDE FIVE THOUSAND SEVEN HUNDRED UNVERIFIED, TYPE UNKNOWN, CLIMBING.

An ATC unit shall inform a radar identified aircraft when the traffic is no longer of concern if:

- The aircraft states that it does not see the traffic that was issued and
- You are not providing radar separation.

Example:
CLEAR OF PREVIOUS TRAFFIC.
CLEAR OF PREVIOUS TRAFFIC AT 3 O'CLOCK.

3. Non-radar traffic information

The non-radar traffic information is applicable for the IVAO following position:

- TWR – tower controller if your position cannot give air traffic control service (ex: AFIS)
- FSS – Flight service station

3.1. Source of information

Non-radar traffic information shares the same source as radar traffic information.

Traffic information may be based on:

- Visual observation
- Observation of all radar targets
- Reports from pilots or other ATS facilities.

A non-radar controller can have a radar feedback but radar identification shall not be possible. He can use the radar information in order to provide traffic information.

In IVAO, we have 3 cases:

- Radar targets when using the IvAc radar screen (main information in IVAO)
- Visual observation when using IvAi and your flight simulator with a tower view
- Reports from pilots or other ATS facilities when any problems occur during a server crash. Information can be obtained via radio communication with pilots or coordination in text mode with other controllers.

3.2. Application

An ATC unit shall issue position information and traffic information, as necessary, to assist aircraft in establishing visual separation from other aircraft.
An ATC unit shall also issue traffic information on an aircraft's request.

An ATC unit shall provide traffic information to:

- VFR aircraft in Class C and D airspace
- VFR aircraft in Class E airspace if workload permits
- IFR aircrafts (if any)

Include the following items in non-radar traffic information:

- Position of aircraft.
- Direction of flight.
- Type of aircraft.
- Altitude.
- ETA for the reporting point nearest the point at which the aircraft will pass, overtake, or approach, if appropriate

Example:
TRAFFIC 15 MILES EAST OF YORKTON NORTHWESTBOUND CESSNA 180, FOUR THOUSAND FIVE HUNDRED FEET, ESTIMATING YORKTON 1205Z
TRAFFIC 20 MILES EAST OF KILLALOE, A WESTBOUND KING AIR, EIGHT THOUSAND FEET, ESTIMATED KILLALOE AT 2115.

The altitude may be described as (number of feet) above or below.

Provide safety alerts and relevant traffic information as appropriate and do not issue control instructions that would contradict a pilot's RA instructions when an aircraft under your control jurisdiction informs you that it is responding to an ACAS/TCAS or GPWS/TAWS Resolution Advisory (RA).

4. Traffic information on ground

The ground traffic information is applicable for the IVAO following position:

- GND – ground controller

4.1. Source of information

Traffic information may be based on:

- Visual observation
- Observation of all radar targets
- Reports from pilots or other ATS facilities.

A ground controller can have a radar feedback but radar identification shall not be possible. He can use the radar information in order to provide traffic information.

In IVAO, we have 3 cases:

- Radar targets when using the IvAc radar screen (main information in IVAO)
- Visual observation when using IvAi and your flight simulator with a tower view
- Reports from pilots or other ATS facilities when any problems occur during a server crash. Information can be obtained via radio communication with pilots or coordination in text mode with other controllers.

4.2. Application

An ATC unit shall issue position information and traffic information, as necessary, to assist aircraft in establishing ground separation from other aircraft.
An ATC unit shall also issue traffic information on an aircraft's request.

An ATC unit shall provide traffic information to:

- all aircraft
- all vehicles on airport area shared with aircraft (ex: follow me car in IVAO).

Traffic information can include the following items in ground traffic information:

- Position of aircraft.
- Direction of taxi or pushback
- Aircraft action.
- Type of aircraft.

Example:
TRAFFIC BOEING 737, ON TAXIWAY ALPHA, FROM RIGHT TO LEFT, TAXIING TO HOLDING POINT RUNWAY 29 VIA BRAVO
TRAFFIC ON YOUR RIGHT, CESSNA 208, MAINTAINING TAXIWAY CHARLIE ONE

The ground traffic information is usually given with an instruction like "taxi", "maintain position" or "give way".

Example:
AEA333, MAINTAIN POSITION, TRAFFIC BOEING 737, ON TAXIWAY ALPHA, FROM RIGHT TO LEFT, TAXIING TO HOLDING POINT RUNWAY 29 VIA BRAVO



WHICH AIR TRAFFIC CONTROLLER TO CONTACT

1. Introduction

This article is written in order to explain to all beginners in the IVAO network the basics for any pilot to contact the correct air traffic controller.

1.1. Abbreviation list

ATC = Air Traffic Controller.
DEL = Clearance Delivery ATC position
GND = Ground ATC position
TWR = Tower ATC position
DEP = Departure ATC position
APP = Approach ATC position
CTR = Control ATC position (other name can be 'radar' or 'centre' depends of the country regulation)
IFR = Instrument Flight Rules
VFR = Visual Flight Rules

1.2. Organization

In this article we try to explain the basics of aeronautical airspace and the controlled ATC positions.

There will be two main chapters depending on the flight rules you use as a pilot on the network:

- **Visual Flight Rules or VFR**: the pilot operates his aircraft with visual reference to the ground, and by visually avoiding obstructions and other aircraft under Visual Meteorological Condition (VMC).
- **Instrument Flight Rules or IFR**: the pilot operates his aircraft using instrument navigation and he can fly on Instrument Meteorological Condition (IMC).

Advice for beginner pilots:
If you do not know the basic instrument navigation (IFR, SID/STAR, IAF, VOR, ILS …), try the visual navigation (VFR) first, with a small aircraft and away from big airports.

All commercial aircraft (A320, B737, A380, B777…) are flying using instrument navigation in Instrument Flight Rules (IFR). You must know the basic of instrument navigation and IFR rules in order to handle this type of aircraft in IVAO.

The majority of small single engine aircraft is flying using visual navigation in Visual Flight Rules. These types of flight are sometimes called general aviation flights.

2. Airspace Class Basics

The airspaces, where aircraft fly, are classified with parameters like flight rules, radio contact, clearances. In order to have more information about airspaces classification, please read documentation that explains this subject in detail in the IVAO Training Department Web Site.

2.1. Mandatory contact zone

A pilot must contact an active air traffic controller in order to obtain a clearance before he enters in:

- an aerodrome circuit
- a class A, B, C, D, and E airspace if the flight rule performed is IFR
- a class (A), B, C and D if the flight rule performed is VFR
- a prohibited zone as a special operation aircraft
- a restricted zone activated by NOTAM or by Current Special Operation Activities

2.2. Facultative contact zone

A pilot can contact an active air traffic controller in order to obtain traffic information before he enters in:

- a class E airspace if the flight rule performed is VFR
- a class F and G airspace for all flight

In accordance with local regulations, or number of traffic, an air traffic controller may not give you any service.

3. While performing an IFR flight

3.1. You are on the ground (IFR)

When connected to IVAO as a pilot, you have the following possibilities:

- Park at a gate or on an apron
- Park close to any taxiway if there is no apron
- Park close to any runway if there is no taxiway

We remind you that to connect on runways and taxiways is forbidden
Please always consult the charts before any IFR flight plan.

Then before moving on the airfield, you must check if any ATC is in service in your area.

You must check and contact the active ATC **using** IvAp in the following order:

- DEL
- GND
- TWR
- APP
- CTR

Please note the position usage information:

- **DEL, GND and TWR positions** have the same ICAO code which is the airfield's one.
- **APP positions** can have the same ICAO code as the airfield's one, but in some airports, the APP position controls several airfields. In consequence, the APP position can also have a different ICAO code.
- **CTR positions** usually have different call signs. You must be aware of the local FIR call sign.
- **DEL position** will deliver **only IFR clearance** and shall be contacted first as an IFR flight.

Be aware that sometimes the en-route controller (CTR position) will not control you but, he will give a clearance and/or a contact point if you cross his airspace. The contact with this position is mandatory.

If there is no active ATC controlling your airfield and the airspace above, you must set your radio COM active frequency to UNICOM 122.800MHz:

- You shall make self-announcements on this frequency
- You can start your flight in conjunction with traffic around which announces their intentions on the same frequency.

The priorities are given by the rules of the air and these rules are mandatory.

Be aware that engine start up is the responsibility of the pilot in command and not the ATC.

3.2. You fly (IFR)

If you perform an IFR flight, you must know that you are potentially in controlled airspace for the duration of your flight.

As a pilot in the IVAO network, you should check for air traffic control on a regular basis and contact the appropriate air traffic control station when requested to do so.

3.2.1. You fly in high altitude airspace

If you are in high altitude airspace, you need to check for active ATC CTR positions (or FSS for special areas).

The altitude, at which you can consider that you are at high altitude, is usually FL245. This limit can change between FL195 to FL295 depending on your country regulations.

You must check and contact the active ATC **using** IvAp:

- When ATC requests so, with receiving a message via IvAp
- Two minutes before entering his controlled area

IVAO approved software which monitors the network activity can be used for checking ATC online.

3.2.2. You fly in low altitude airspace and final approach not intercepted

If you fly in low altitude airspace (in transit, climbing or descending), you should check if there is an active ATC in CTR or APP position available.

Be aware that at lower altitudes (Example: FL<195), you may cross some areas controlled by another approach controller different from your departure or arrival airport. You must contact this ATC in order to obtain a transit clearance through his airspace.

You must check and contact the active ATC using IvAp:

- When ATC requests so, with receiving a message via IvAp
- Two minutes before entering his controlled area

An Approach APP controller has a controlled area named TMA. This controlled zone is around the airport, the upper limit of which is generally below FL195.

The TMA form represented in some software displaying the network activity is a circle. Be aware that the majority of these TMA's are not depicted as circles and their dimensions are not limited by the circle. Consult where possible the appropriate charts in order to verify the entry point in each TMA.

3.2.3. You intercept the final approach

If you are intercepting the final approach and you are not controlled, it means the approach is not controlled by any ATC. In this situation you should check if there is a TWR position available at your destination airport.

You must check and contact the active ATC using IvAp:

- When ATC requests so, with receiving a message via IvAp
- Just before intercepting the IFR final approach or when established on IFR final approach at the latest

The TWR controller does not control the approach zone.

If there is traffic in the vicinity of your aircraft, a pilot can request traffic information during initial approach in order to coordinate with ATC a safe arrival to the final approach.

If there is no TWR controller at your destination airport but there is **an active GND controller**, you can continue your flight until the runway is vacated, then contact the GND controller without moving after leaving the active runway**. You must wait for a clearance from the GND controller in order to taxi to the assigned gate.**

4. While performing a VFR flight

4.1. You are on the ground (VFR)

When connected to IVAO as a pilot, you have the following possibilities:

- Park at the general aviation apron or on the main apron if it does not exist
- Park close to any taxiway if there is no apron
- Park close to any runway if there is no taxiway

We remind you that to connect on runways and taxiways is forbidden

Before moving on the airfield, you must check if any control is provided for your airfield. Sometimes, small airfields are in class G airspace and no ATC can open the position. In that case, you can start your flight on UNICOM frequency 122.800 MHz using self-announcement about your intentions and ground movements.

If the airfield you are departing from has ATC service, you must check and contact the active ATC using IvAp in the following order:

- GND
- TWR
- APP
- (CTR)

Please note the position usage information:

- **DEL, GND and TWR positions** have the same ICAO code which is the airfield's one.
- **APP positions** can have the same ICAO code as the airfield's one, but in some airports, APP position controls several airfields. In consequence, the APP position can also have a different ICAO code.
- **CTR positions** usually have different call signs. You must be aware of the local FIR call sign.

Be aware that sometimes the en-route controller (CTR position) will not control VFR flights in controlled areas. Some can only provide traffic information and movement advisories.

If there is no active ATC controlling your airfield and the airspace above, you must set your radio COM active frequency to UNICOM 122.800MHz:

- You shall make self-announcements on this frequency
- You can start your flight in conjunction with all traffic around which announces their intentions on the same frequency.

The priorities are given by the rules of the air and these rules are mandatory.

As a VFR pilot, you can start the engine prior to contact the ATC. Usually on first contact, the VFR pilot is ready to taxi.

4.2. You fly (VFR)

When you perform a VFR flight, you must know that you are potentially in controlled airspace in some areas or all along your flight depending on the route chosen.

As a pilot in the IVAO network, you should check for air traffic control on a regular basis and contact the appropriate air traffic control station when requested to do so.

4.2.1. You fly and you do not enter any aerodrome circuit or aerodrome controlled area (CTR)

If you fly outside any control zone (CTR) or outside any aerodrome traffic circuit (in transit, climbing or descending), you should check if ATC is active in CTR or APP position.

Be aware, you may cross some areas controlled by another approach controller different from your departure or arrival airport. You must contact this ATC in order to obtain a transit clearance through his airspace. Contact with a CTR will depend on your local regulations.

You must contact this active ATC:

- When ATC requests so, with receiving a message via IvAp
- Two minutes before entering his controlled area

An Approach APP controller has a controlled area named TMA. This controlled zone is around the airport and the upper limit is generally below FL195.

The TMA form represented in some software displaying the network activity is a circle. Be aware that the majority of these TMA's are not depicted as circles and their dimensions are not limited by the circle. Consult where possible the appropriate charts in order to verify the entry point in each TMA.

Note that in some countries there is a **FSS** position (flight service station). The contact with this station is optional but helpful in order to gain information.

4.2.2. You are going to enter an aerodrome circuit or an aerodrome controlled area (CTR)

If you are going to enter an aerodrome circuit or an aerodrome controlled area (CTR), you should check if there is a TWR position available and open for this airfield.

Be aware that this ATC can control the airspace even if you only wish to transit the airspace, not only the departure and arrival airfield.

You must contact this active ATC:

- When ATC requests so, with receiving a message via IvAp
- 2 minute before entering the aerodrome circuit or an aerodrome controlled area (CTR)

The TWR controller does not control the approach zone.

If there is no TWR controller at your destination airport but there is **an active GND controller**, you can continue your flight until the runway is vacated, then contact the GND controller without moving after leaving the active runway**. You must wait for a clearance from the GND controller in order to taxi to the assigned gate.**



HEADWIND & CROSSWIND CALCULATION

1. Introduction

When flying, the winds create effects on the aircraft trajectory. The winds push the aircraft in the air and the pilot shall compensate this effect in order to land, to perform navigation, to follow radio navigation aid radials or tracks…

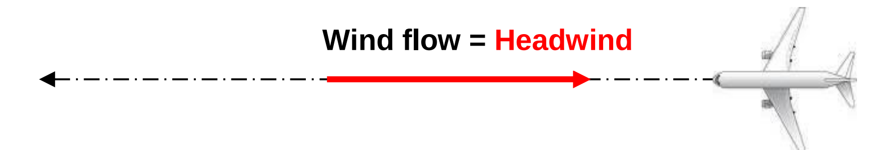
The wind value can be taken from METAR information or can be found on complex navigation instruments.



2. Headwind, tailwind and crosswind definitions

2.1. Headwind

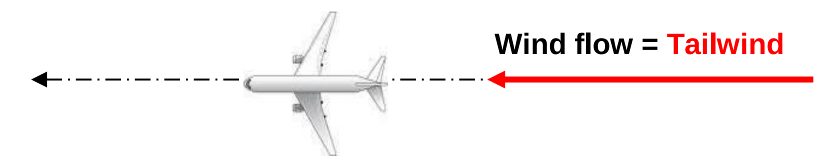
If the winds are pure headwinds, the aircraft will face the wind. The crosswind component is null. The direction of travel is the opposite direction of the wind.



This configuration is the best for landing and taking-off procedures.

2.2. Tailwind

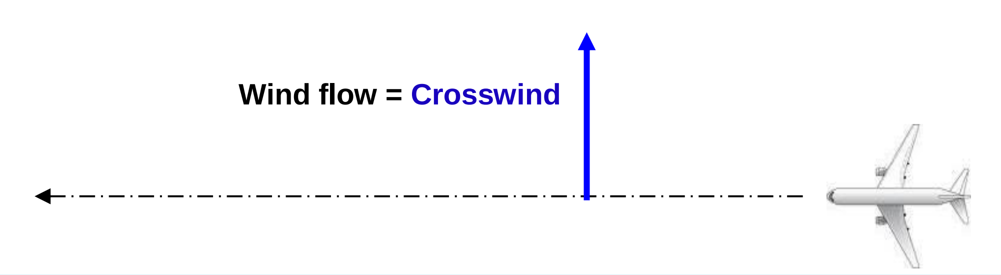
If the winds are pure tailwinds, the aircraft will follow the wind. The crosswind component is null.
The direction of travel is the same direction of the wind.



This configuration is the best in en-route phase to save time of travel.

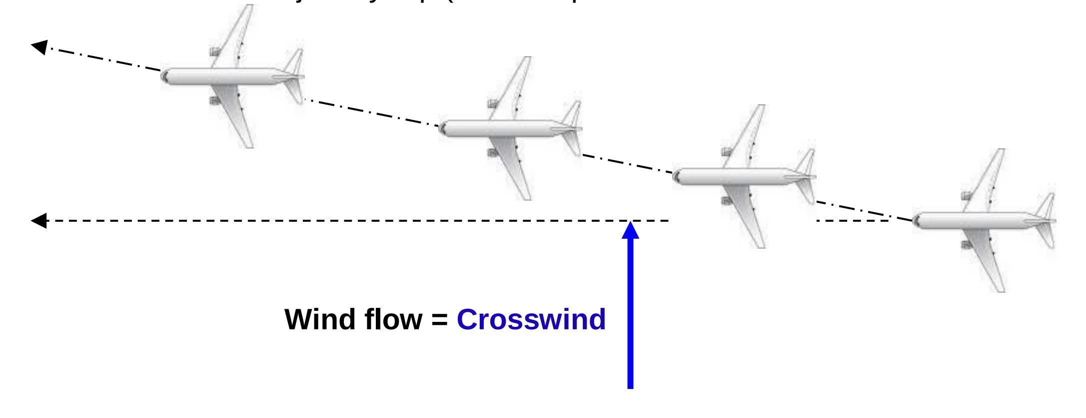
2.3. Crosswind

If the winds are pure crosswind, the direction of travel is perpendicular to the wind direction.
The headwind and the tailwind are null. The cross wind can be from left to right (like the example below) or from right to left (opposite direction of the example below)



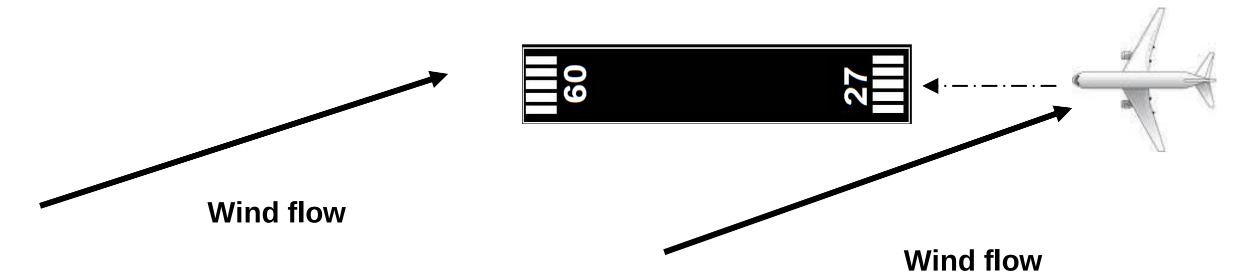
This configuration will not gain time in the en-route phase and will just make the landing a little bit challenging if the crosswind component is sufficiently high.

Crosswind ~~wind~~ will create trajectory slip (wind will push the aircraft off the desired track.



3. Generic wind configuration

The wind flow does not follow the runway axis all the time. It often comes from the left or the right.

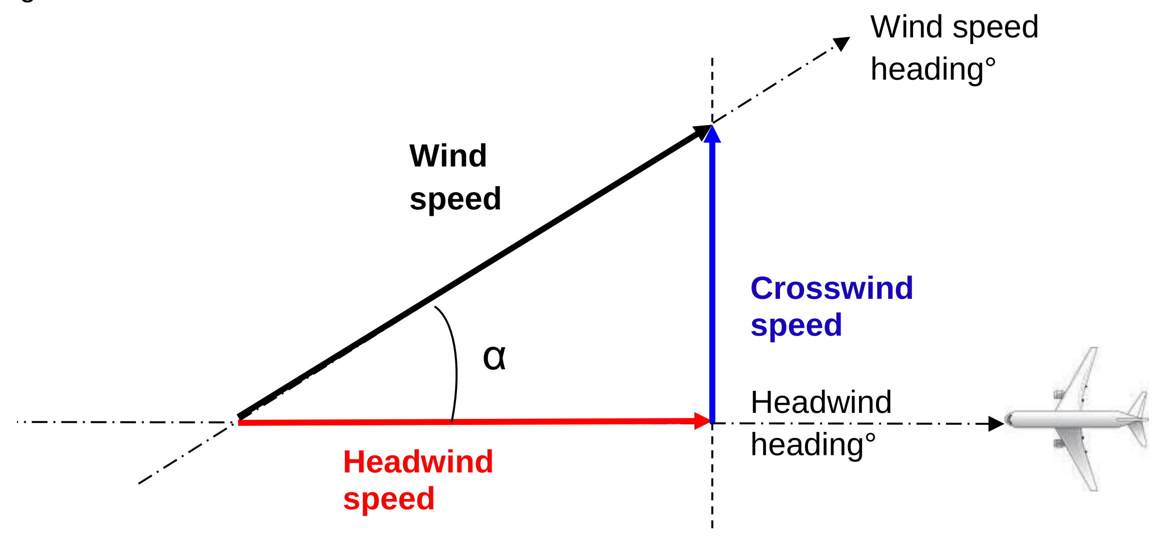


A wind flow shall be separated in two parts:

- a **headwind** blows against the direction of travel or a **tailwind** blows ~~on~~ in the same direction of travel
- a **crosswind** blows using perpendicular to the direction of travel (from the left or from the right)

3.1. Headwind configuration

α is the angle of the wind from direction of travel.



α = (Wind speed heading° - Headwind Heading°)

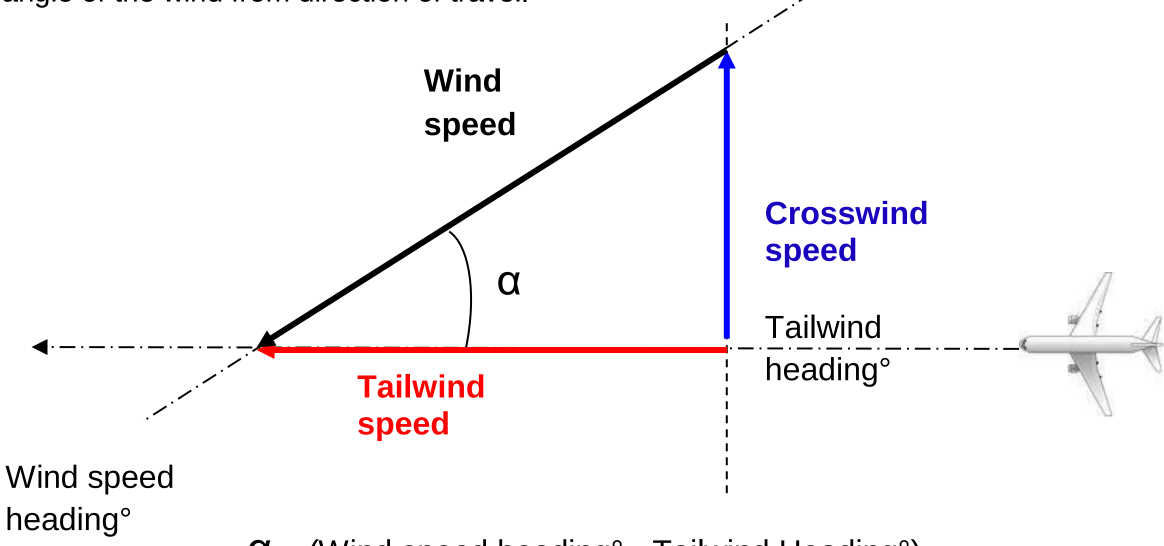
Headwind heading = Aircraft heading

The angle shall be: -90° < α < +90°

Note that METAR heading of the wind is the heading of the aircraft which has the wind in front

3.2. Tailwind configuration

α is the angle of the wind from direction of travel.



α = (Wind speed heading° - Tailwind Heading°)

Tailwind heading = Aircraft heading ± 180°

The angle shall be: -90° < α < +90°

4. Tailwind, headwind and crosswind in function of the runway

Using the same wind, tailwind and crosswind values are different for each runway used!

According to the image, the wind direction is coming from the north.

For a take-off, we will have:

- a headwind if aircraft use runway 36
- a tailwind if aircraft use runway 18
- a crosswind from the left if aircraft use runway 09
- a crosswind from the right if aircraft use runway 27

If you have a tailwind for a runway, the opposite runway will have the same wind but in headwind configuration.

If you have a headwind for a runway, the opposite runway will have the same wind but in tailwind configuration.

If you calculate, the tailwind, headwind and crossing values, you must calculate the values for each runway.

Wind speed

18

09

27

36

5. Calculation

We now calculate the crosswind and headwind (tailwind) speeds using the angle α and METAR information:

Crosswind speed = wind speed * sin (α)

Headwind speed (or tailwind) = wind speed * cos (α)

The **sin** (sine) and **cos** (cosine) are complex mathematical functions. We propose some conversion tables in order to not have a scientific calculator with you.

This table below is the conversion of sine and cosine functions:

α	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
sin α	0	0.17	0.34	0.5	0.64	0.77	0.86	0.94	0.98	1
cos α	1	0.98	0.94	0.86	0.77	0.64	0.5	0.34	0.17	0

During flight, a pilot has no time to use complex calculations. For approximation, a pilot can use a simpler table for wind calculation.

Here are approximated crosswind and headwind speeds for a wind speed value = 10.

α	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
Crosswind	0	0	3	5	6	7	8	9	10	10
Headwind (tail)	10	10	9	8	7	6	5	3	0	0

Example:
Wind speed = 8KT
Aircraft heading = 60°
Wind speed heading in METAR = 100°
Note that in METAR, the direction given use headwind reference, 100° is the track to have in order to have full headwind.

We are in headwind configuration, so Headwind = Aircraft heading° = 60°.
α = 100° - 60° = 40°
True calculation (using calculator): Crosswind = 8 * sin(40°) = 5.14 KT Headwind = 8 * cos(40°) = 6.12 KT
First table calculation: Crosswind = 8 * 0.64 = 5.12 KT Headwind = 8 * 0.77 = 6.16 KT ➔ error < 1%
Second table calculation: Crosswind = 8 * 6/10 =4.8 KT Headwind = 8 * 7/10 = 5.6 KT ➔ error < 10%



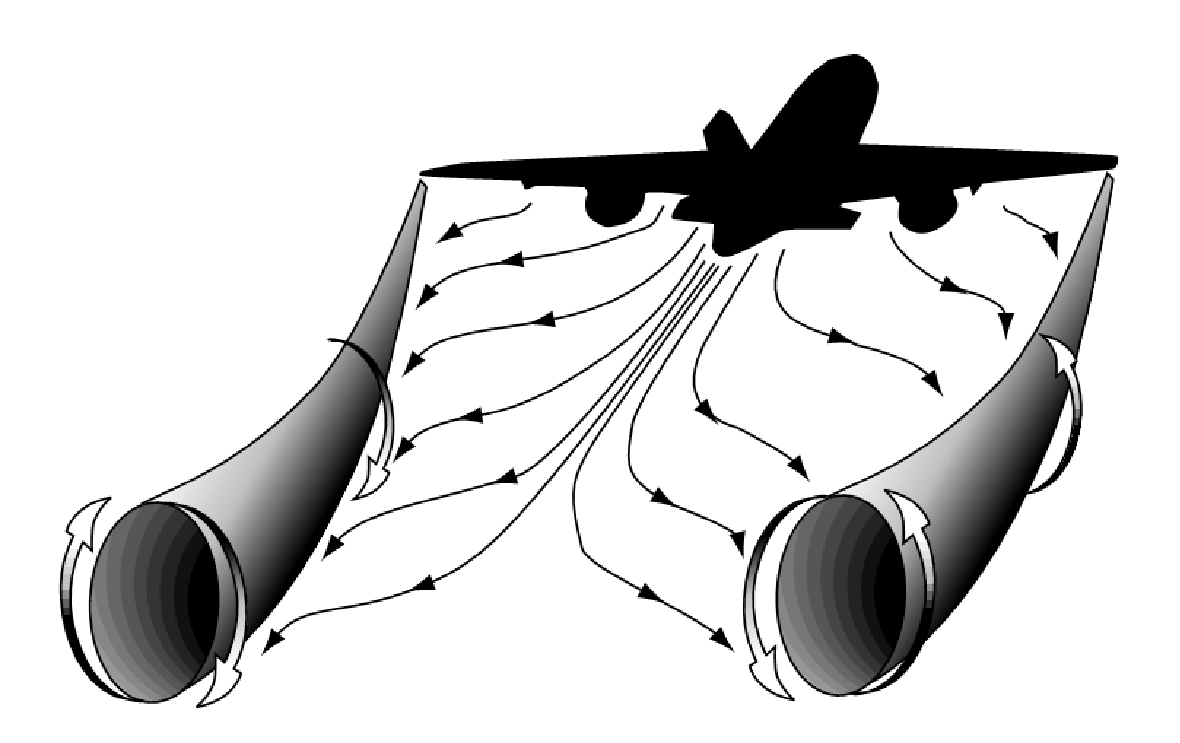
WAKE TURBULENCE

1. Definition and creation

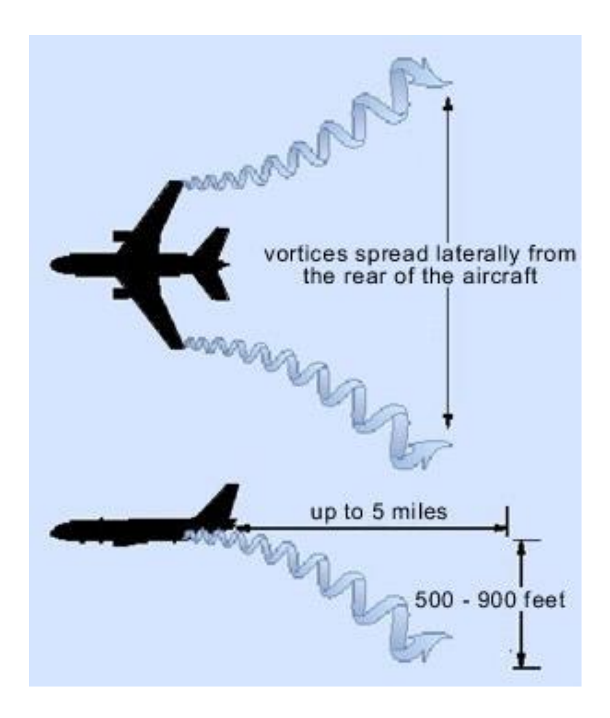
Wake turbulence is turbulence that forms behind an aircraft as it passes through the air, causing wingtip vortices.

Wake vortices are formed any time an air foil is producing lift.
All aircraft produce wake turbulence.

Lift is generated by the creation of a pressure differential over the wing surface. The lowest pressure occurs over the upper wing surface and the highest pressure under the wing. This pressure differential triggers the roll up of the airflow aft of the wing resulting in swirling air masses trailing downstream of the wing tips. After the roll up is completed, the wake consists of two counter-rotating cylindrical vortices. This starts the wake vortex.



Wake vortices spread laterally away from the aircraft and descend approximately 500 to 900 feet at distances of up to five miles behind it. These vortices tend to descend at approximately 300 to 500 feet per minute during the first 30 seconds



Wingtip vortices are stable and can remain in the air for up to three minutes after the passage of an aircraft, making it the primary and most dangerous component of wake turbulence.

2. Effect when flying behind wake turbulence

The greatest hazard from wake turbulence is induced roll and yaw. This is especially dangerous during take-off and landing when there is little altitude for recovery.

Aircraft with short wingspans are most affected by wake turbulence.

Depending on the location of the trailing aircraft relative to the wake vortices, it is most common to be rolled in both directions.

The most dangerous situation is for a small aircraft to fly directly into the wake of a larger aircraft. This usually occurs while flying beneath the flight path of the larger aircraft. Small aircraft following larger aircraft may often be displaced more than 30 degrees in roll.

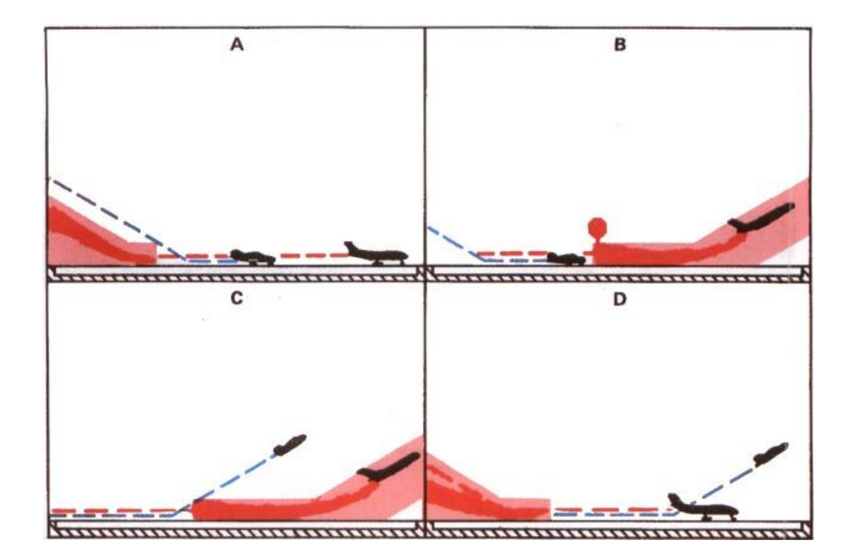
If the aircraft is flown between the vortices, high roll rates can coincide with very high sink rates in excess of 1000 feet per minute. Depending on the altitude, the outcome could be tragic.

Aircraft with smaller wingspans generate more intense wake vortices than aircraft with equivalent weights and longer wingspans. The Boeing 757, for example, has a relatively short wing and large power plant for the weight of the aircraft. The wake turbulence that is produced by the 757 is equivalent to that of a much heavier aircraft.

3. Wake turbulence avoidance procedure

In order to avoid conflicts with wake turbulence, certain procedures are also observed by the pilots with regard to wake turbulence.

- Landing traffic will land beyond the touchdown point of the preceding aircraft. (**A**)
- Landing traffic will land prior to the departing aircraft's rotation point. (**B**)
- Departing aircraft will lift off (if possible) prior to preceding aircraft's rotation point. (**C**)
- Departing aircraft will lift off past the preceding aircraft's touchdown point. (**D**)



4. Wake turbulence categories of aircraft

There are several wake turbulence categories depending on maximum take-off mass (MTOM) of the considered aircraft.

They are categorized by a letter in a flight plan L, M, H or J:

- **L = Light** = maximum take-off mass < 7000 kilograms (15,000 lb)
- **M = Medium** = 7000 kilograms < maximum take-off mass < 136,000 kilograms
- **H = Heavy** = maximum take-off mass >136000 kilograms (300,000 lb)
- **J = Super** = specific category for Airbus A380 (Jumbo)

Keep in mind that the pilots' call sign has to be followed by a simple word "**heavy**" or "**super**" **on initial contact** when the aircraft is in aircraft category H or J.



AIRSPACE INFRINGEMENT

1. Introduction

Airspace infringement occurs when an aircraft penetrates airspace for which explicit prior clearance is required without having such a clearance

A major cause of airspace infringement is poor navigation, leading to penetration of the controlled airspace or danger, restricted or prohibited area concerned.

2. Contributory Factors and Effects

The contributory factors:

- Lack of knowledge or understanding of procedures for obtaining clearance to enter or cross controlled airspace
- Failure to follow correct procedures for crossing or entering controlled airspace
- Inadequate basic training in appropriate navigational techniques
- Lack of expertise of pilots in equipment operation, especially GPS
- Adverse weather
- Inadequate pre-flight preparation
- Routine (assumption that airspace restrictions on a familiar route will not change) Frequency congestion;
- Pilot preoccupation with other tasks.
- Unfavourable attitude of ATC controllers to VFR flights

Here are the major effects of airspace infringement (we present only the effects linked with IVAO):

- Loss of Separation from other aircraft, which may result in collision
- Perceived security risk if area is penetrated
- Disruption of military or other special activities within restricted, danger or prohibited airspace
- Distraction of controller from other tasks

3. Example of airspace infringement

3.1. Air traffic controller effect

An aircraft approaching an area requests crossing clearance:

- The frequency is busy and the controller instructs the pilot to "Stand by". The pilot continues on track and enters the area without any clearance.
- The controller acknowledges the call but does not immediately approve the request. The pilot assumes that the acknowledgement constitutes clearance and enters the airway.

3.2. Pilot effect

An aircraft operating VFR doesn't properly identify his position on the ground due to partial cloud cover and enters the controlled airspace without permission.

A pilot navigating by reference to NDB and/ VOR beacons makes an error in determining his position and enters a Restricted/Danger/Prohibited area.

A pilot, using GPS, incorrectly programs the equipment and follows a track which diverges from the planned route, and enters a Restricted/Danger/Prohibited area.

A pilot using an out of date chart enters the Restricted/Danger/Prohibited area without awareness.

4. Solutions to reduce airspace infringement

Solutions shall include improved training of pilots in navigation techniques, including:

- Visual navigation
- Use of radio navigation aids
- Use of GPS
- Transponders to enable aircraft to be identified by ATS and to enable TCAS alerts

There are solutions for a pilot perspective:

- Improve airspace infringement awareness
- Be prepared and call air traffic controller well in advance (3 to 5 minutes flying time)
- Use the correct phraseology to obtain the clearance you want without confusion
- Think about what you are going to say before you press the transmit switch
- Be aware that air traffic controller may be busy even if the controller isn't talking on the frequency
- Remember that the instruction "Standby" is not a clearance
- Remain outside controlled airspace if you don't have any clearance
- Effective Pre-flight briefing
- If the weather starts to deteriorate, consider your options early
- Use the correct charts up to date
- Check your transponder active using Traffic alert (via IvAp)

There are solutions for an air traffic controller perspective:

- Flight Information Services to VFR flights based on the use of radar
- Aeronautical and meteorological information to VFR flights
- Expect the unexpected
- Area Proximity Warning (APW) that can alert controllers of potential or actual infringements (not simulated in IVAO)
- Review airspace design (only for national regulation authorities)



VFR GENERAL AVIATION FLIGHT OPERATION

1. Introduction

The general aviation flight operation is the operation of an aircraft other than a commercial air transport operation.

The commercial air transport flight operation is the flight operation involving the transport of passengers, cargo or mail for remuneration or hire.

1.1. Duties of pilot-in-command

The pilot-in-command shall be responsible for the operation, safety and security of the aeroplane and the safety of all crew members, passengers and cargo on board.

2. Flight operation

The pilot-in-command shall ensure that a flight will not commence unless it has been ascertained by every reasonable means available that the ground (or water), including radio communication or navigation aids available are adequate for the type of operation under which the flight is to be conducted.

2.1. Aerodrome operating minima

The pilot-in-command shall not operate to or from an aerodrome using operating minima lower than those which may be established for that aerodrome by the state in which it is located (except specific approval).

2.2. Flight preparation

A flight shall not be commenced until the pilot-in-command is satisfied that:

- Aircraft is registered with the appropriate certificates (*not applicable in IVAO*)
- The instruments and equipment installed are appropriate taking into account the expected flight conditions
- Any necessary maintenance has been performed (*not applicable in IVAO*)
- The mass of the airplane and centre of gravity location are such that the flight can be conducted safely
- Any load carried is properly distributed and safely secured (*not applicable in IVAO*)
- The aeroplane operating limitations, contained in the flight manual, will not be exceeded.

2.3. Flight planning

Before starting a flight, the pilot-in-command shall be familiar with all available meteorological information appropriate to the intended flight.
Preparation for a flight away from the vicinity of the place of departure shall include:

- A study of available current weather reports and forecast
- The planning of an alternative course of action to provide for the eventuality that the flight cannot be completed as planned because of weather conditions.

2.4. Weather conditions using visual flight rules

A flight to be conducted in accordance with the visual flight rules (VFR) shall not be commenced unless current meteorological reports and forecasts indicate that the meteorological conditions along the route or that part of the route to be flown under visual flight rules will be such as to render compliance with these rules.

2.5. Fuel and oil supply for VFR flights

A flight shall not be commenced unless taking into account both meteorological conditions and any delays that are expected in flight, and the aeroplane carries sufficient fuel and oil to ensure that it can safely complete the flight.

When the flight is conducted in accordance with the visual flight rules, the amount of fuel to be carried must permit:

- For VFR flight during day time, the flight to the aerodrome of intended landing with an additional flight time for at least 30 minutes at normal cruising altitude

- For VFR flight during night time, the flight to the aerodrome of intended landing with an additional flight time for at least 45 minutes at normal cruising altitude

2.6. Non applicable subject for IVAO

The regulation also takes into account subjects like:

- Re-fuelling with passengers on board
- Oxygen supply
- Passenger safety equipment
- Incapacited flight crew members or passenger injury.

The documentation will not consider these items as they are not used in the IVAO network.

3. Large and turbojet aeroplanes

The following operation chapter shall be subject to the international general aviation operation with:

- Aircraft with a maximum certificated take-off weight exceeding 5700kg (M>5700kg)
- Aircraft equipped with one or more turbojet engines

All information given in the previous chapter is also applicable for large and turbojet aeroplanes.

3.1. Checklists

Checklists shall be used by flight crews during all phases of operations, and in emergencies, to ensure compliance with the operating procedures contained in the aircraft operating manual.

3.2. Take-off alternate aerodrome

A take-off alternate aerodrome shall be selected and specified in the flight plan if the weather conditions at the aerodrome of departure are at or below the applicable aerodrome operating minima or it would not be possible to return to the aerodrome of departure for other reasons.

The take-off alternate aerodrome when required shall be located within the following distance from the aerodrome of departure:

- For aeroplanes having 2 engines, not more than a distance equivalent to a flight time of 1 hour at single-engine cruise speed
- For aeroplanes having 3 or more engines, not more than a distance equivalent to a flight time of 2 hours at one-engine inoperative cruise speed

4. Aeroplane performance operating limitations

An aeroplane shall be operated in compliance with its certification approved documents and within the operating limitations prescribed by the certificating authority.

The pilot-in-command shall determine that aeroplane performance will permit the take-off and departure to be carried out safely.

5. Aeroplane equipment

Note that in this section, we will not describe all the inboard equipment that is not applicable for IVAO (life jackets, oxygen, flight recorders, microphone, fire extinguisher, data link recorders and emergency locator system…)

5.1. VFR flight

All aeroplanes when operating VFR shall be equipped with a means of measuring and/or displaying:

- Magnetic heading
- Pressure altitude
- Indicated airspeed
- Equipment displaying time in hours minutes and seconds
- Additional equipment which may be prescribed by local authority

Regulation recommends that VFR flights which are operated as controlled flights should be equipped in accordance with IFR operation.

5.2. Night VFR flight

All aeroplanes when operating night VFR shall be equipped with a means of measuring and/or displaying:

- Magnetic heading (standby compass)
- Pressure altitude
- Indicated airspeed with a means of preventing malfunctioning due to either condensation or icing
- Turn and slip
- Aircraft altitude
- Stabilized aircraft heading
- Supply of power to the gyroscopic instruments is adequate
- Outside air temperature
- Rate-of-climb and descent
- Equipment displaying time in hours minutes and seconds
- Additional equipment which may be prescribed by local authority

In addition to these requirements, aircraft with a maximum certificated take-off weight exceeding 5700kg or aircraft equipped with one or more turbojet engines shall be equipped with 2 independent altitudes measuring and display systems.

In addition, an aeroplane shall be equipped with:

- The lights required in flight and on the movement area of an aerodrome
- A landing light
- Illumination for all flight instruments and equipment

5.3. Ground proximity warning systems - GPWS

All turbine-engined aeroplanes with a maximum certificated take-of mass greater than 5700kg shall be equipped with a ground proximity warning system which has a forward looking terrain avoidance function.

5.4. Emergency power supply

Aeroplanes of a maximum certificated take-off mass of over 5700kg (after 1/1/1975), shall be fitted with an emergency power supply independent of the main electrical generating system, for the purpose of operating and illuminating for a minimum period of 30 minutes, an attitude indicating instrument (artificial horizon). This emergency power system shall be automatically operative after the total failure of the main electrical generating system.

5.5. Airborne collision avoidance system (ACAS)

All turbine-engined aeroplanes with a maximum take-off mass in excess of 15000kg or authorized to carry more than 30 passengers shall be equipped with airborne collision avoidance system (ACAS II) and airworthiness certificate was first issued after 1/1/2007.

Regulation recommends ACAS II for all turbine-engined aeroplanes greater than 5700kg.

In IVAO, the IvAp interface gives the opportunity to activate a TCAS system which can be considered to be the required ACAS.

6. Aeroplane communication and navigation equipment

6.1. Communication equipment

An aeroplane to be operated using visual flight rules (VFR) in controlled flights shall be provided with radio communication equipment capable of conducting two-way communication at any time during flight with air traffic controller.

The radio communication equipment shall also provide for communication on the aeronautical emergency frequency 121.500MHz.

In IVAO, the radio communication is given by the IvAp interface using text communication or via Teamspeak using voice communication. Only VHF frequencies are simulated including 121.500MHz (Guard frequency).

6.2. Navigation equipment

An aeroplane shall be provided with navigation equipment which will enable it to proceed:

- In accordance with the flight plan
- In accordance with the requirement of air traffic services

Navigation for flights under visual flight rules is accomplished by visual reference to landmarks.



THE RUNWAY CONSTRUCTION

1. Introduction

A runway is a rectangular area of an aerodrome prepared for the landing and take-off of aircraft.

The runway is the most critical part of an airfield. An accident on a runway will affect the airport availability and any accident on a runway generally causes several reasons of damage and injuries in the real life.

2. Runway characteristics

A runway shall be characterized by the following parameters:

- Runway orientation
- Runway length and width
- Runway surface type
- Runway sections
- Runway strength

2.1. Runway orientation

Runways are named by a number between 01 and 36, which is generally the magnetic azimuth of the runway's heading in multiple of 10 degrees.

A runway numbered 09 points east (90°), runway 18 is south (180°), runway 27 points west (270°) and runway 36 points to the north (360° rather than 0°).

If there is more than one runway pointing in the same direction (parallel runways), each runway is identified by appending Left (L), Centre (C) and Right (R) to the number to identify its position (when facing its direction).

However, runways in North America that lie within the Northern Domestic Airspace of Canada are numbered relative to true north because proximity to the magnetic North Pole makes the magnetic declination large.

2.2. Runway sections

A runway can have different sections that can be used by aircraft for taxi, landing or taking-off operation.

The normal used portion of the runway is from threshold to opposite threshold, but does not include overrun, blast pad or stop way areas at both ends.



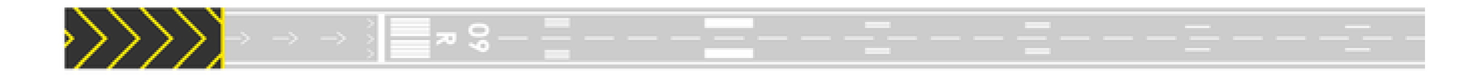
Example of a runway with number 09 R

2.2.1. Stop way or blast pad

Blast pad, overrun areas or stop ways are often constructed just before the start of a runway where jet blast produced by large planes during the take-off roll could otherwise erode the ground and eventually damage the runway.

Overrun areas are also constructed at the end of runways as emergency space to slowly stop planes that overrun the runway on a landing gone wrong, or to slowly stop a plane on a rejected take-off or a take-off gone wrong. Blast pads are often not as strong as the main paved surface of the runway and are marked with yellow chevrons.

Planes are not allowed to taxi, take-off or land on blast pads, except in an emergency.

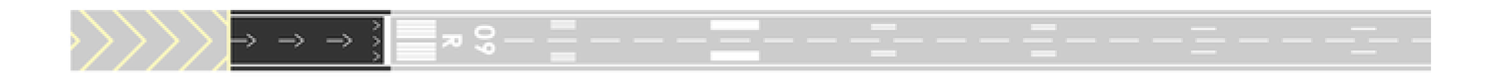


2.2.2. Displaced threshold

A displaced threshold exists because obstacles just before the runway, runway strength, or noise restrictions may make the beginning section of the runway unsuitable for landings.

It is marked with white paint arrows that lead up to the beginning of the landing portion of the runway.

Displaced thresholds may be used for taxiing, take-off, and landing rollout, but not for touchdown and landing operations.



2.2.3. Runway closed

When a runway is closed, there is a permanent or temporary cross on the runway.

If you see a cross on the runway or in the charts, this runway is closed and it is forbidden to land on a closed runway (except for emergency purposes).



2.3. Surface types

The choice of material used to construct the runway depends on the use and the local ground conditions.

In the biggest airport, you will find long hard surface type runways (asphalt and concrete). In the smallest airport, you can find only a soft surface type runway (grass and gravel).

The most common surface types are.

- ASP Asphalt
- BIT Bituminous Asphalt or Tarmac
- BRI Bricks (no longer in use, covered with Asphalt or Concrete now)
- CLA Clay
- COM Composite
- CON Concrete
- COP Composite
- COR Coral (Coral reef structures)
- GRE Graded or rolled earth, Grass on graded earth
- GRS Grass or earth not graded or rolled
- GVL Gravel
- ICE Ice
- LAT Laterite
- MAC Macadam
- PEM Partially Concrete, Asphalt or Bitumen-bound Macadam
- PER Permanent Surface, Details unknown
- PSP Marsden Matting (Derived from Pierced/Perforated Steel Planking)
- SAN Sand
- SMT Summerfield Tracking
- SNO Snow
- U Unknown surface

Water runways do not have a type code as they do not have physical markings, and are thus not registered as specific runways.

3. Runway length

The runway length is generally:

- 500 to 1000 meters long and 25-45 meters wide for small airfields
- 2000 to 4200 meters long and 45-60 meters wide for the larger airfields

You can find normalized distances on charts.

3.1. TORA = Take Off Run Available

TORA is the length of runway declared available and suitable for the ground run of an airplane taking off. This means the maximum run distance for an aircraft during a take-off.



3.2. RESA = Runway End Safety Area

RESA is the length of the stop way.



3.3. CWY = Clearway

A clearway is an area beyond the paved runway, free of obstructions and under the control of the airport authorities. The length of the clearway may be included in the length of the take-off distance available (TODA).



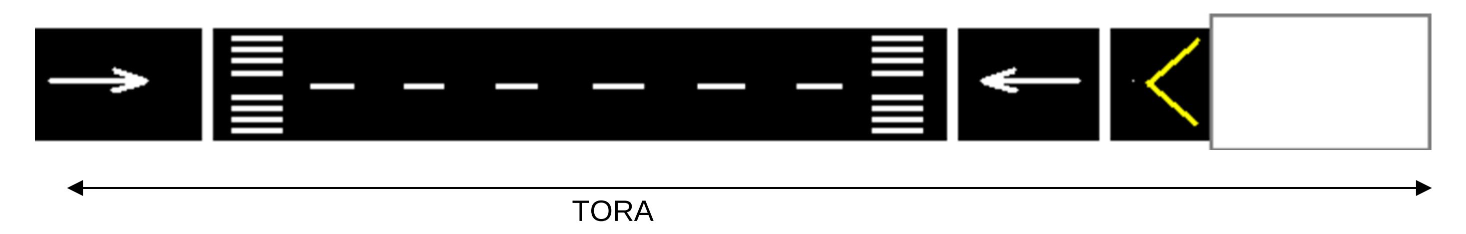
3.4. TODA = Take Off Distance Available

TODA is the length of the take-off run available plus the length of the clearway and stop band, if clearway or stop band is provided.

This distance is the take-off distance for an aircraft to reach the minimum 50ft.

Clearway is an area beyond the paved runway, free of obstructions. Clearway allows large airplanes to take off at a heavier weight than would be allowed if only the length of the paved runway is taken into account.

TODA = TORA + RESA + CWY



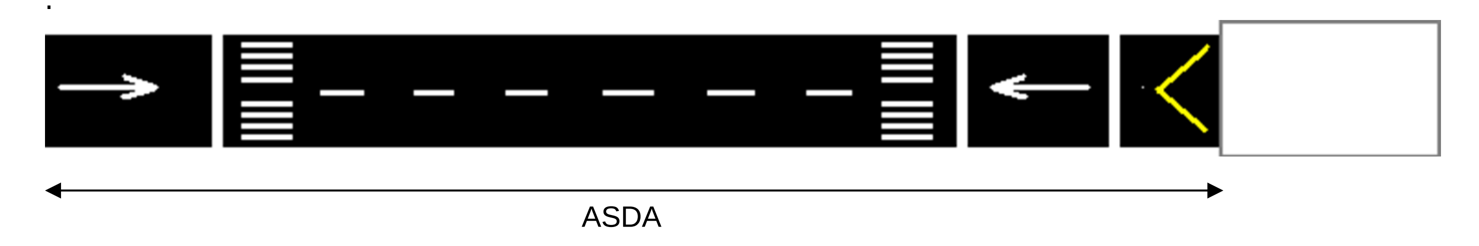
3.5. ASDA = Accelerate-Stop Distance Available

ASDA is the length of the take-off run available plus the length of the stop way, if stop way is provided



ASDA = TORA + RESA

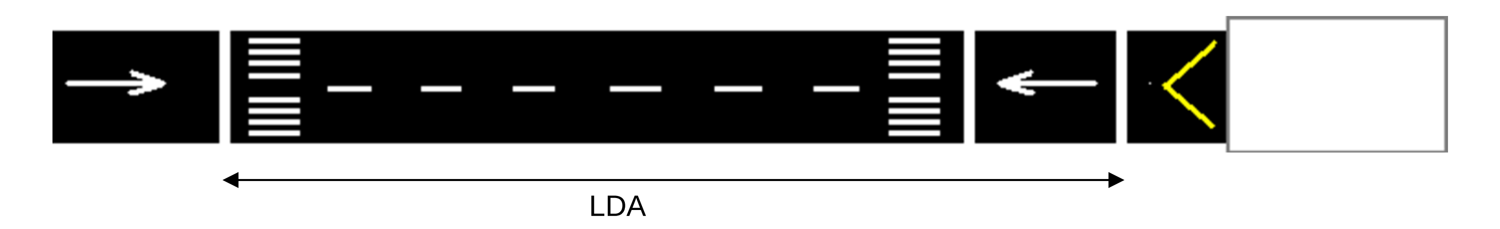
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ASDA is the maximum run distance for an aircraft when performing a rejected take-off.

3.5.1. LDA = Landing Distance Available

LDA is the length of runway that is declared available and suitable for the ground run of an airplane landing.

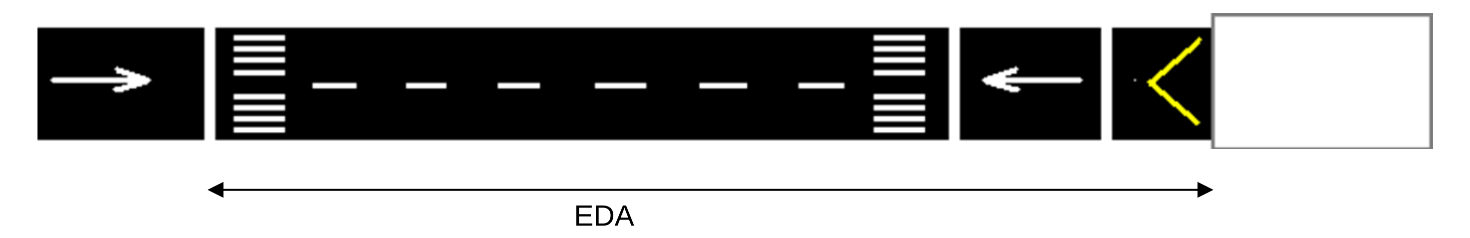


LDA never includes runway section before displaced threshold before touchdown point.

3.5.2. EDA = Emergency Distance Available

EDA is the maximum length of runway available for an emergency landing.

EDA=LDA+RESA





AERODROME LIGHTING SYSTEM

1. Introduction

This chapter will show the wide variety of approach lighting systems before the runway threshold and systems present on runways.

2. Runway approach ramps

2.1. Simple version of approach lights

A simple version of approach lighting consists of a low intensity white centreline and cross bar. It starts 500m prior to the runway threshold (the green lights).

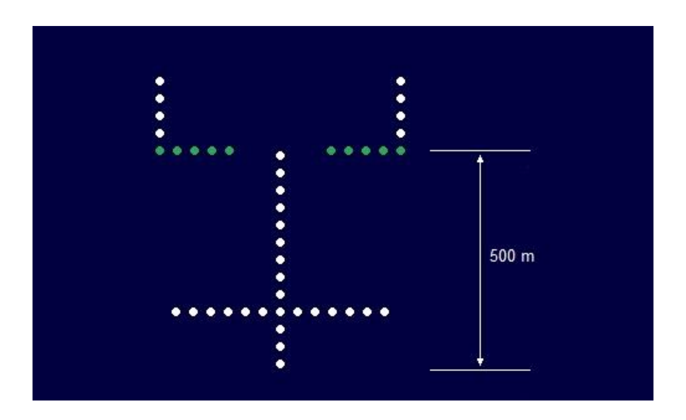


Figure: simple approach light system

2.2. Precision version of approach lights

Airfields can have more complex approach lighting systems used mainly in association with ILS equipped runways.

A well-known system is the Calvert Approach lighting system.

The Calvert system consists of a white centreline and 5 white cross bars. It commences 900m prior to the runway threshold (see the next figure).

At aerodromes where CAT II and III approaches are conducted, supplementary approach lights are added to the system.

Supplementary approach lights are installed the last 300m prior the runway threshold, consisting of a **white** centreline barrette and two **red** side barrettes.

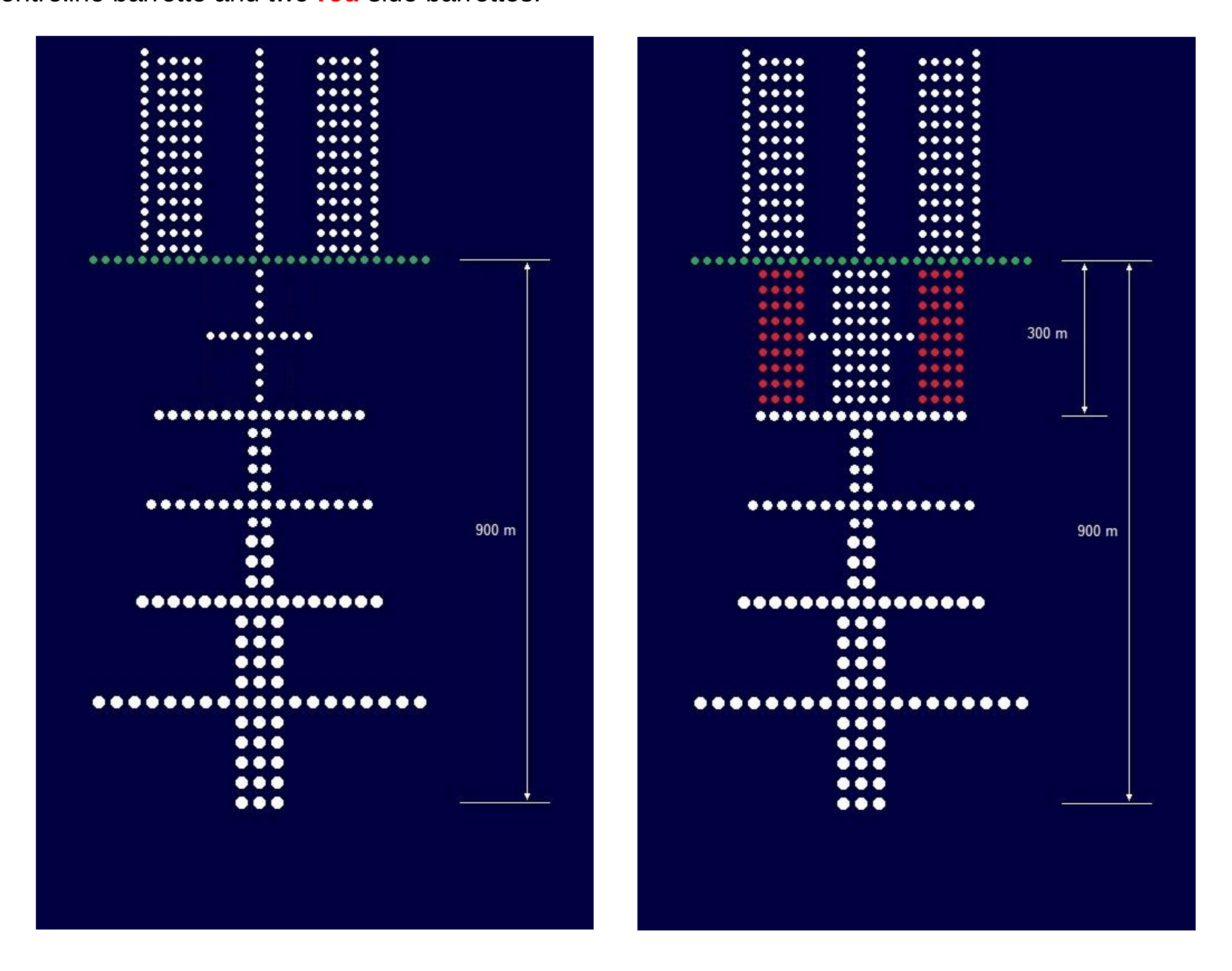


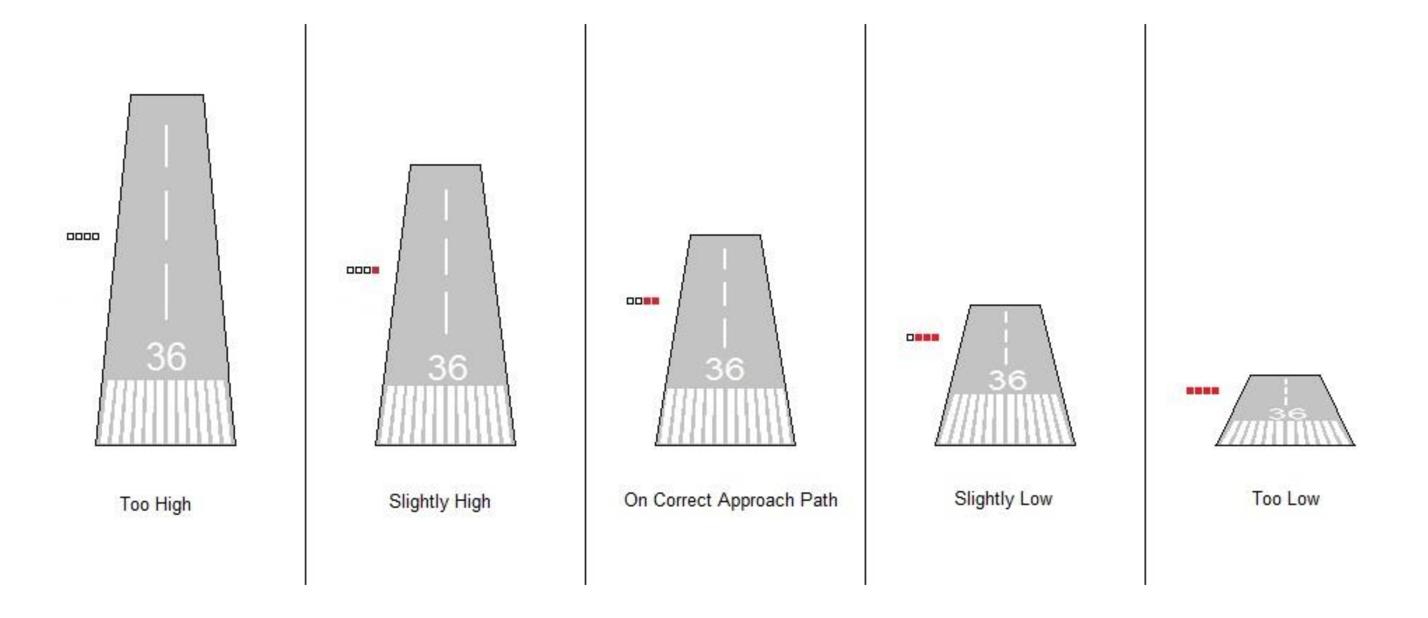
Figure: both Calvert approach light systems

3. Visual Approach Slope Guidance

3.1. Precision Approach Path Indicator (PAPI)

The PAPI provides a visual aid to determine the correct approach path.

It consists of a single row of 4 **red** and **white** lights. The colour is depending on the vertical angle as shown in the illustration hereunder.



PAPI’s are not designed to be used outside 15° of the runway centreline.

PAPI’s are usually situated to the left side of the runway. However, where this is impracticable, it may be installed on the right side of the runway. There also are aerodromes where PAPI’s are placed on both sides of the runway.

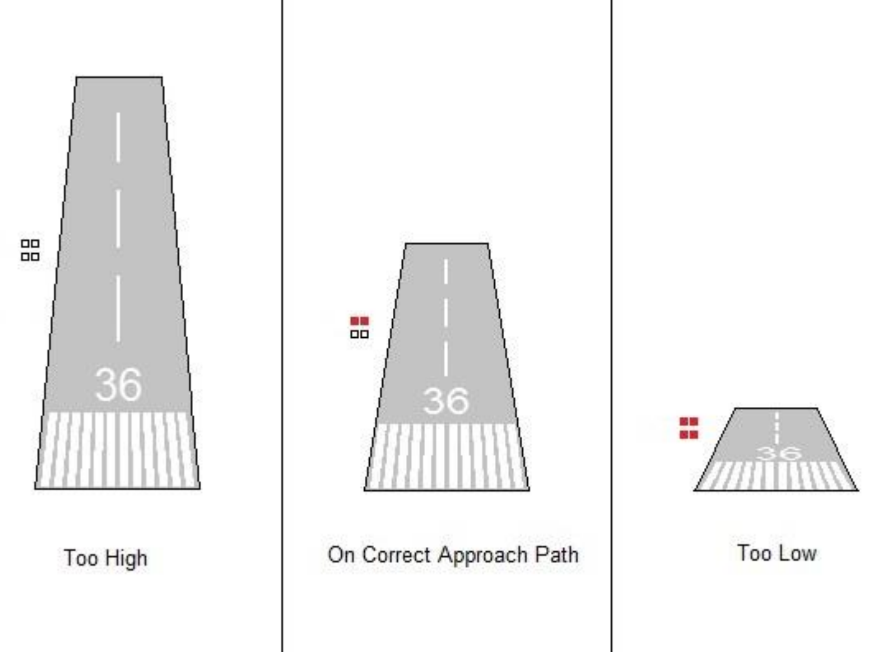
Where a PAPI is used together with an ILS, it is located to align both glide slopes as much as practicable. Any additional restrictions shall be published in the appropriate section in the local AIP.

On runways where no public jet transport is carried out an **Abbreviated PAPI** (**APAPI**) may be installed. **An APAPI consists of only 2 light units**.

3.2. Visual Approach Slope Indicator (VASI)

A VASI system does much the same as a PAPI system. It is just a different presentation.

It consists of two rows of two **red** and **white** lights which presentation is as shown below:

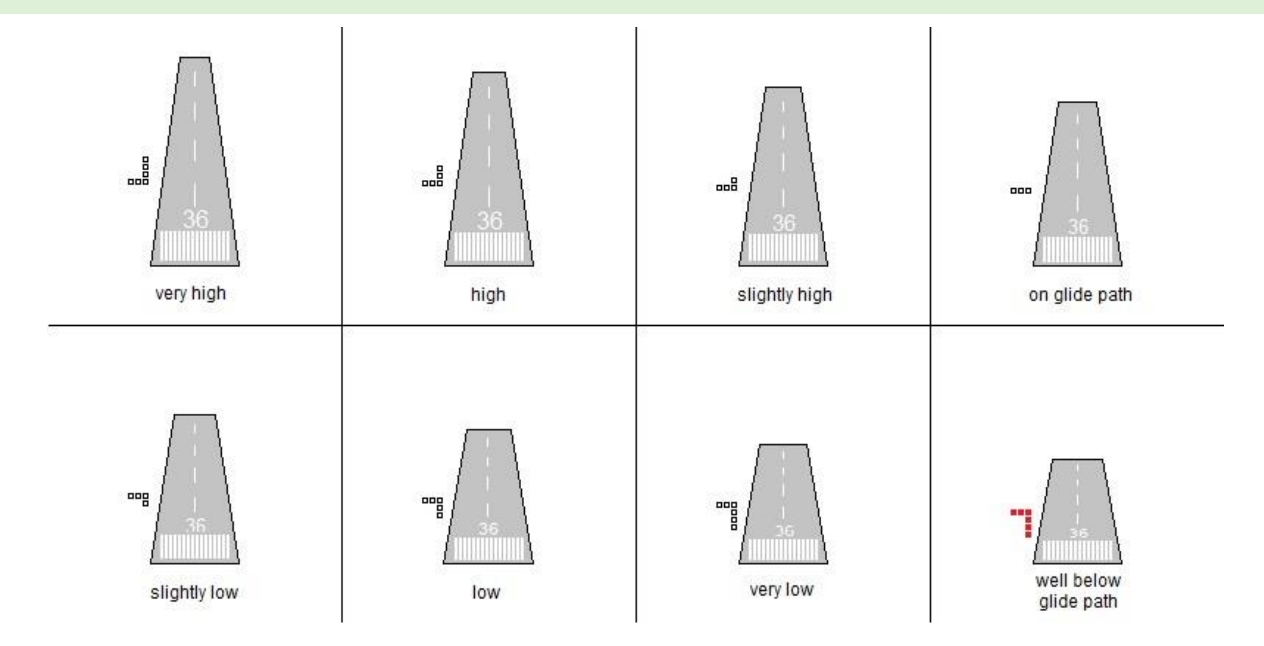


On correct approach path, pilot must see a **red** light row and a **white** light row

There also exists a VASI consisting of three rows. For a normal aircraft the correct approach path in this case would be indicated by two **red** bars and one **white** bar. An aircraft with a high cockpit would have to see one **red** bar and two **white** bars.

3.3. T-VASI

A variation of the VASI is the T-VASI, which presentation is as shown below:



3.4. Runway lighting

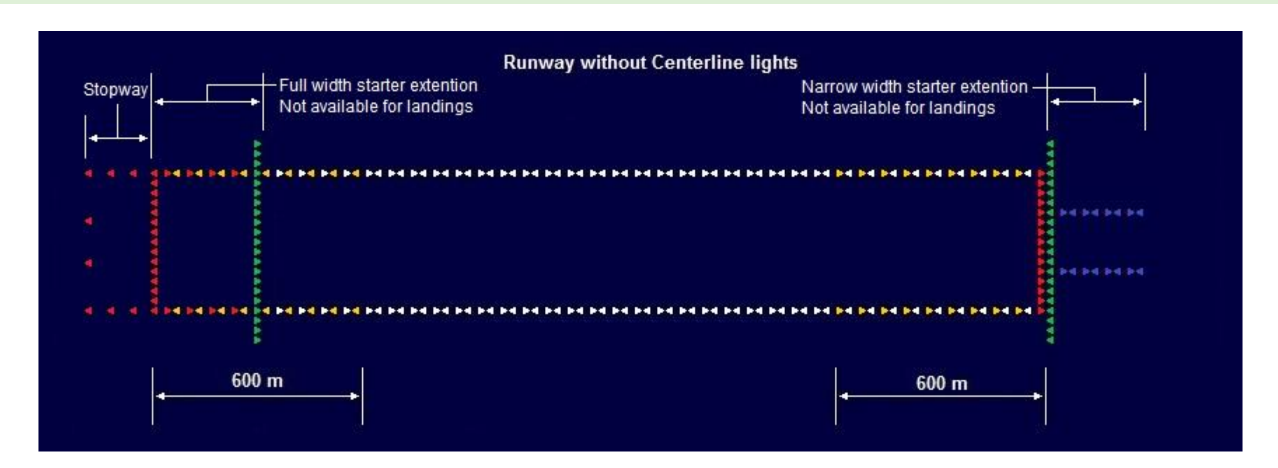
All runways certified for night operations shall have:

- Runway Edge Lights
- Runway Threshold and Runway End Lights

Note that centreline and touchdown zone lights are additional guidance in support of low visibility operations.

3.5. Runway edge lights

Runway Edge Lights are **white** lights situated along the edges of the declared runway width spaced at 60 meters.



They are **white** except for:

- Caution Zone Lights
- Pre-Threshold Lights
- Runway Exit Lights
- Stop way Lights
-

3.5.1. Caution Zone Lights

Yellow caution zone lights are installed on ILS equipped runways without centreline lights, on the last 600m, or one third of the lighted runway length available, whichever is less.

3.5.2. Pre-Threshold Lights

On a runway with a displaced landing threshold (an available area in front of the threshold for the take-off run and not the landing), the runway edge lights from the beginning of the pavement up to the displaced threshold are **red**.
Where the area in front of the threshold is narrower than the associated runway width, the edges are lighted in **blue**.

3.5.3. Runway Exit Lights

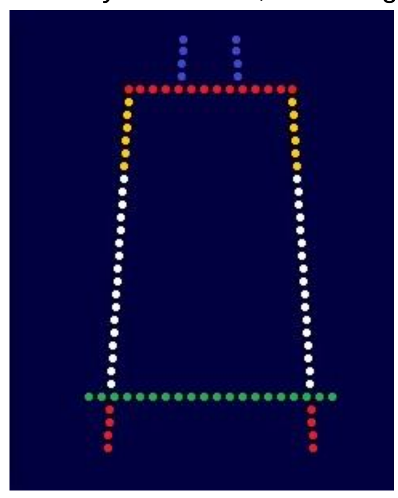
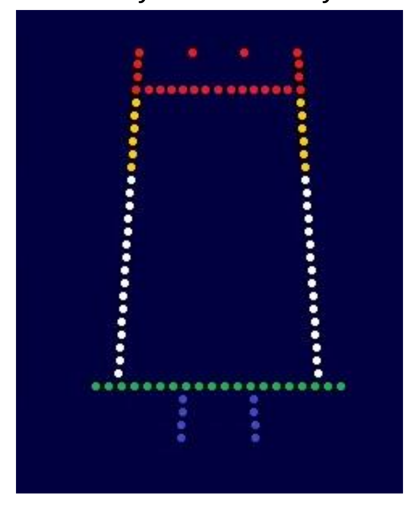
One or two Omni-directional **blue** lights may replace or supplement the edge lights to indicate an exit taxiway.

3.5.4. Stop way Lights

Where a stop way is provided, the edge lights are **red** and facing one way so only the landing traffic is able to see them. A stop way is for emergency use only, and not for routine landings.

3.6. Runway threshold and runway end lights

Runway **Threshold** lights are always seen **green** by a pilot on final, indicating the start of the available landing distance.
Runway **End** lights are always seen **red**, indicating the extremity of the runway available for manoeuvring.

Pilots should not land before the **green runway threshold lights** or not continue the landing roll beyond the red runway end lights.

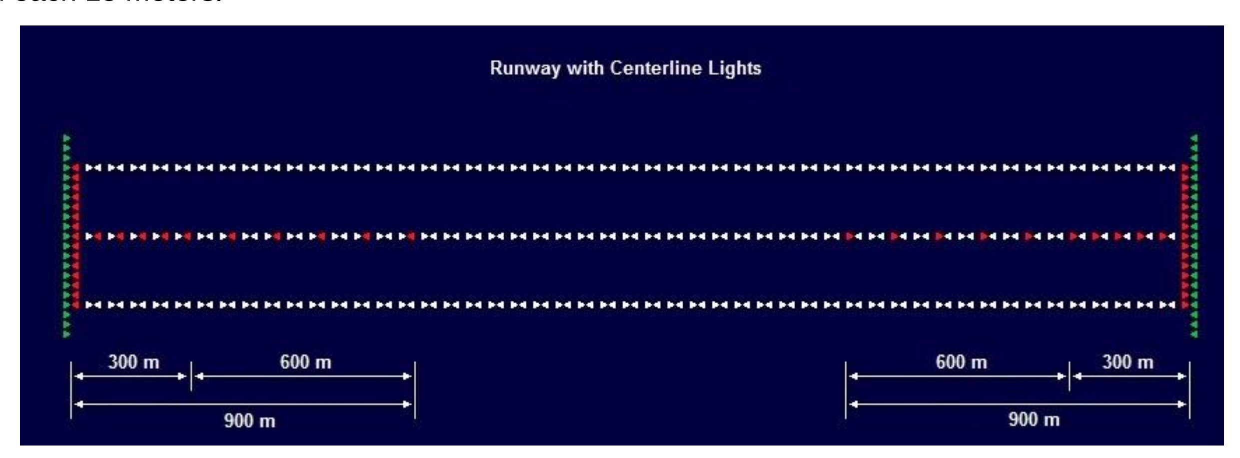
3.7. Runway centreline lights

For runways supporting low visibility operations high intensity runway centreline lights are installed.

Runway centreline lights are colour coded:

- From the threshold until 900 meters from the runway end the centreline lights are **white**.
- The following 600 meters are alternating **red** and **white** lights.
- The last 300 meters are only **red** lights.

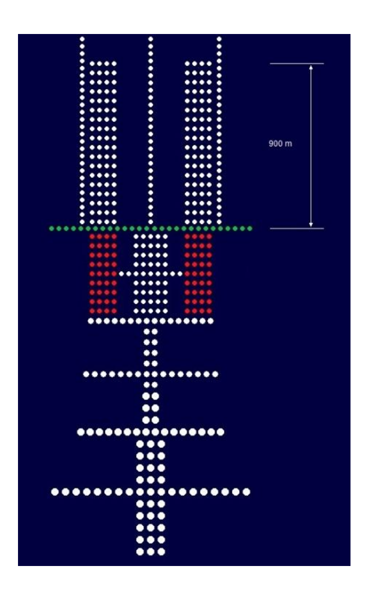
Runway centreline lights are spaced each 30 meters. However for CAT III runway operations, they are spaced each 15 meters.



3.8. Touchdown zone (TDZ) lights

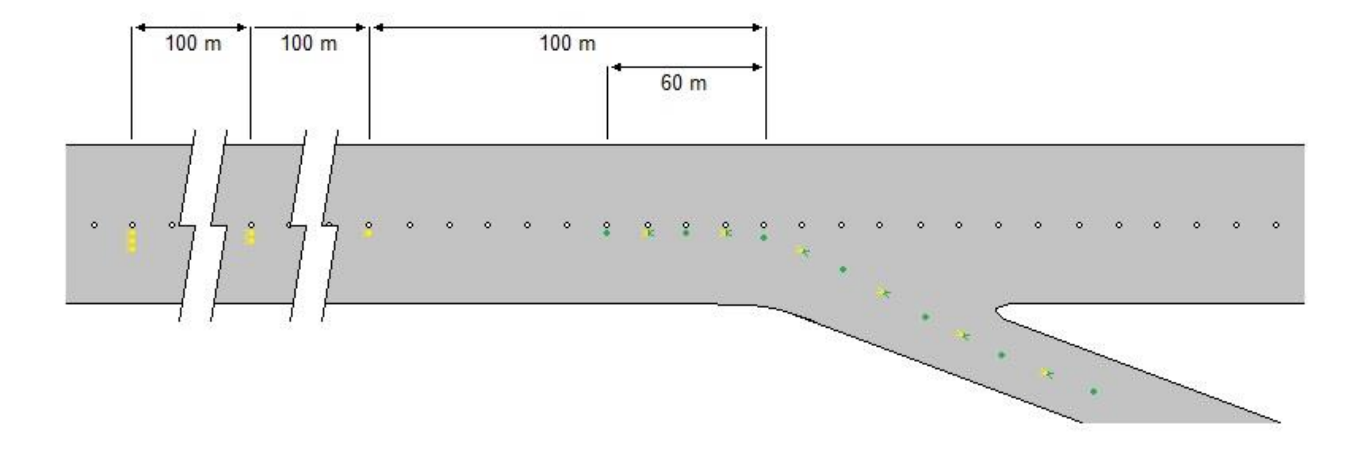
For runways supporting low visibility operations additional touchdown zone lights, consisting of two rows of **white** barrettes are installed.

The touchdown zone lights extend from the threshold light bar for 900 meters or the midpoint of the runway, whichever is the shorter distance.



3.9. Rapid Exit Taxiway Indicator Lights (RETIL)

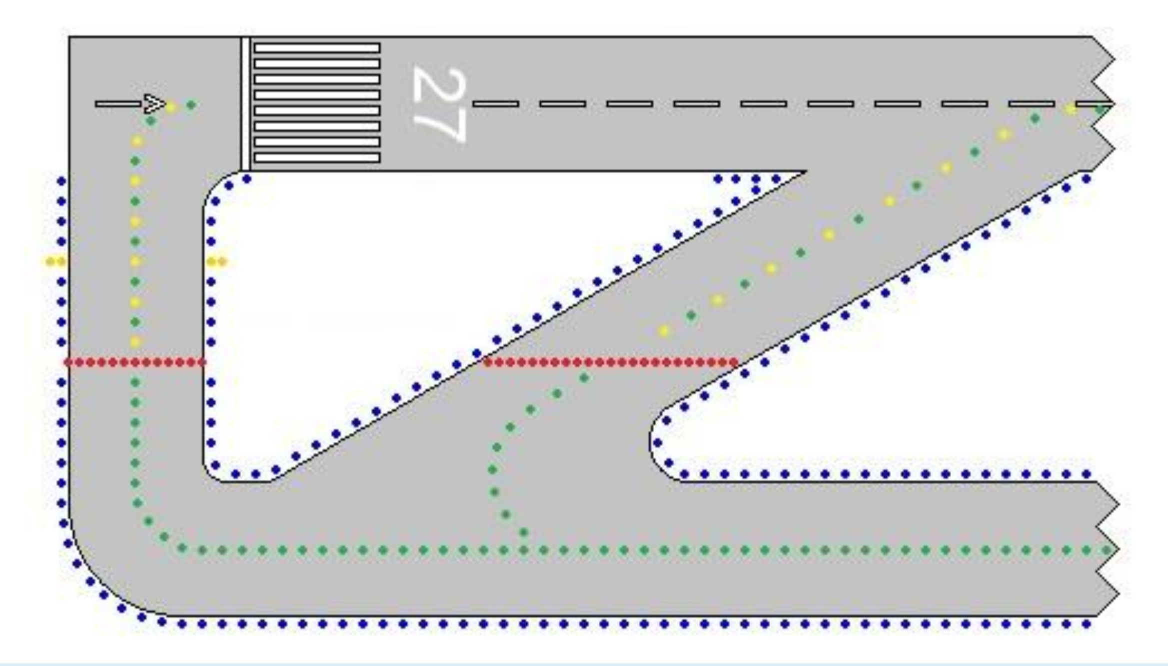
Rapid exit taxiway indicator lights consist of six **yellow** lights in a three/two/one configuration, spaced 100 meters apart (Where the single **yellow** light is situated 100 meters from the start of the turn).



4. Taxiway Lighting

4.1. Taxiway lights

Taxiway edges are provided with **blue** edge lighting.
Green taxiway centreline lights are provided for low visibility procedures (Where **green** centreline lights are provided, **blue** edge lights may also be provided).



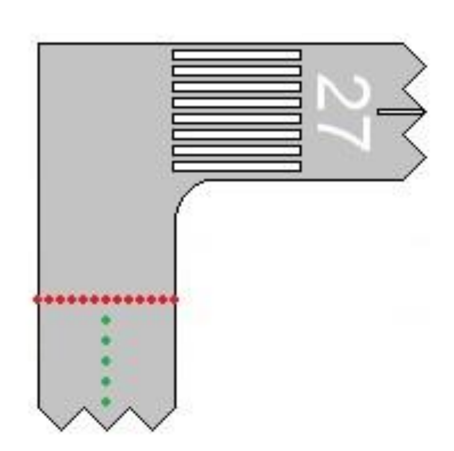
Some aerodromes where CAT II and CAT III operations take place have Taxiway guidance systems installed. However due to limitations of Flight simulation software and IVAO, this will not always be available.
Aerodromes without such guidance systems, but do have complex taxiway intersections, may provide taxiway intersection lights.
They consist of at least 3 steady **yellow** lights, installed symmetrically over the taxiway centreline.
Where taxiway centreline lights are situated within an ILS sensitive area, the lights alternate **yellow** and **green**.

4.2. Stop bar, Lead-on and Lead-off Lights

Aerodromes authorized for low visibility operations have stop bars lights.

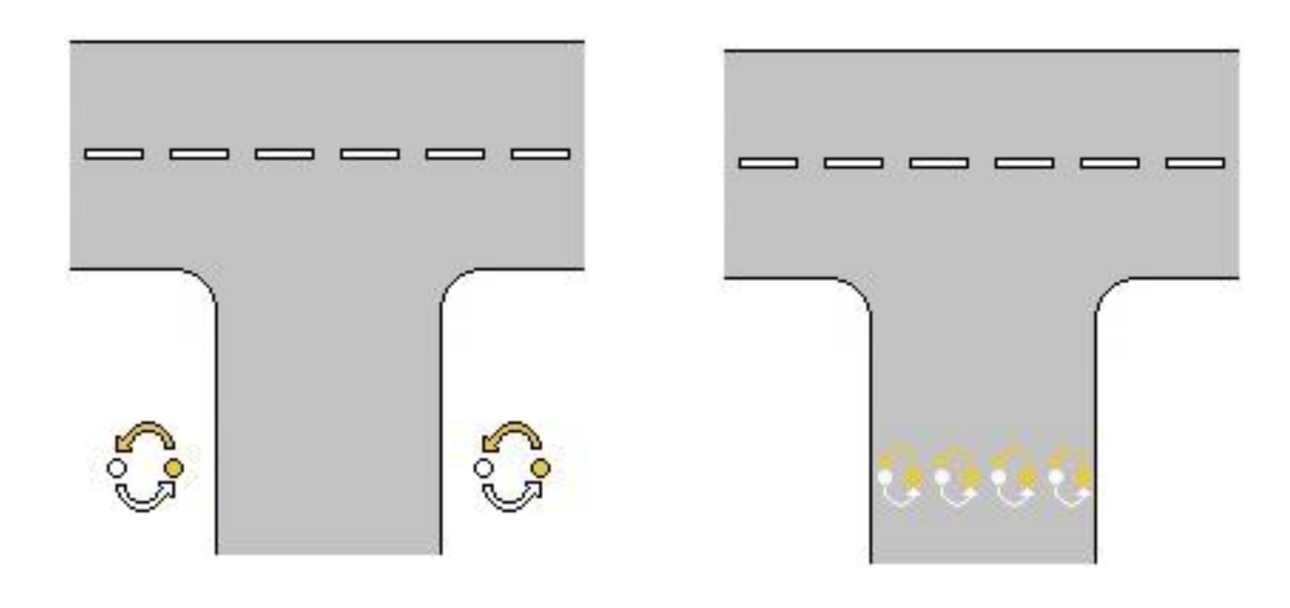
Stop bars lights consist of equally spaced **red** lights across the taxiway at a 90° angle to the taxiway centreline.

Stop bars are situated at runway entry's and holding points. They may also be installed at taxiway intersections (e.g. associated with a taxiway guidance system). Normally stop bars are installed associated with **green** lead-on lights.



4.3. Runway guard lights

Runway guard lights are two pairs of alternately flashing yellow lights. Each pair located next to the taxiway indicating close proximity to the runway. Where a taxiway is wider than usual an alternate variation may be installed, where additional pairs of alternately flashing yellow lights are installed into the taxiway across the full width.





AERODROME MARKINGS AND SIGNALIZATION

1. Introduction

This article will present the main aerodrome markings and signalization on runways and taxiways.

2. Runway Markings

This chapter will show the runway marking signs.

- Runway markings are **white**.
- The only exception is if a pre-threshold area is not suitable for normal movement of aircraft, but only serving as a stop way from the opposite end of the runway. The chevrons indicating such a pre-threshold area are **yellow** markings.

2.1. Marking requirements

Runway marking requirements differ per runway classification:

	Visual runways (LDA < 1200m)	**Non-precision approach runway Visual runways** (LDA >1200m)	**Precision Approach runways**
Runway Designator	Required	Required	Required
Centreline Marking	Required	Required	Required
Threshold Marking	-	Required	Required
Touchdown Zone Marking	-	-	Required
Runway Edge Marking	-	-	Required

2.2. Runway Designator

The runway designator consists of **a two digit number indicating the magnetic runway heading**, rounded to the nearest 10 degrees.

Where parallel runways are located at an aerodrome with the same magnetic heading, the runway designator will include a letter R, L or C:

- "**L**" (Left) indicates the runway situated on the left as seen from the approach,
- "**R**" (Right) indicates the runway situated on the right.
- "**C**" (Centre) exists if there is a third parallel runway, the runway situated in the middle will be designated with the letter "C".

If there are more than 3 parallel runways, the runway designator number must change as per example:
- 1 runway = 26
- 2 runways = 26L, 26R
- 3 runways = 26L, 26C, 26R
- 4 runways = 26L, 26R, 27L, 27R
- 5 runways = 26L, 26C, 26R, 27L, 27R

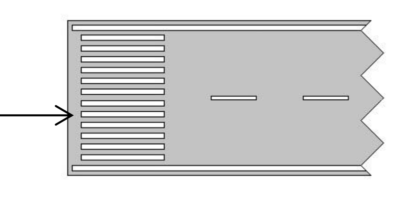
2.3. Runway Centerline

Runway centreline markings are **30 meters long and separated by 30 meters** between each mark.

2.4. Runway Threshold marking

Runway threshold markings are depending on runway width.

Runway width	Number of stripes	Stripe length
18 meters	4	24 meters
23 meters	6	24 meters
30 meters	8	30 meters
45 meters	12	30 meters
60 meters	16	30 meters

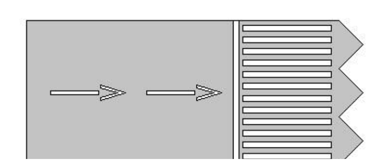


2.5. Pre-threshold marking

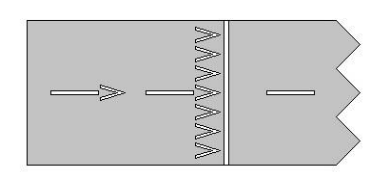
Pre-threshold marking is provided where a runway has:
- a **displaced threshold**
- a **stop way**
- a **closed pre-threshold area**

A displaced threshold is used where not all the runway is available for landing. The white arrows in the pre-threshold area indicate that the surface is fit **for ground movement of aircraft only** (taxiing), and not for landing.

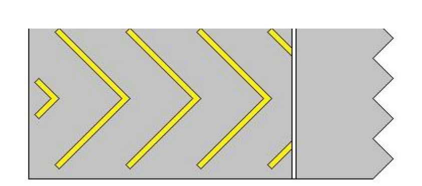
- **Permanent displaced threshold marking** (a threshold which is temporarily displaced but for any duration of six months or more, is considered as permanently displaced for the appropriate marking).



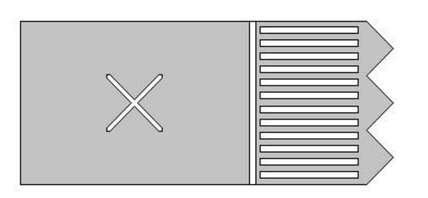
- **Temporarily displaced threshold marking** (the threshold is displaced for a period shorter than six months)



- The yellow chevrons indicate the surface is **unfit for normal aircraft movement**, but **suitable as stop way**.



- The white cross indicates that the surface is **unfit for normal aircraft movement**, and **unsuitable as stop way**.

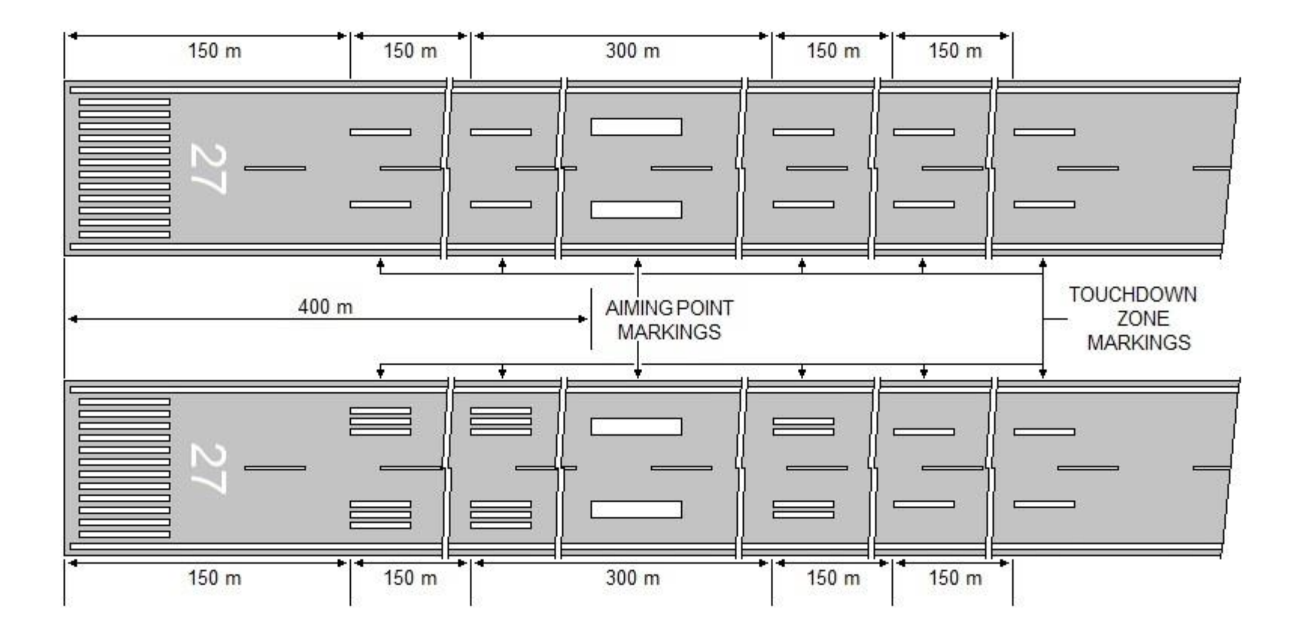


2.6. Touchdown Zone Marking

A touchdown zone is provided for all ILS equipped runways and runways where additional identification of the touchdown zone is required.

Touchdown zone markings consist of **pairs of rectangular markings placed symmetrically to both sides of the runway centreline**. The number of pairs is related to the LDA available:

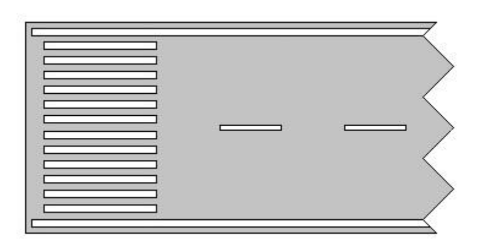
Landing Distance Available (LDA)	Number of marking pairs
LDA < 900m	1
900m < LDA < 1200m	2
1200m < LDA < 1500m	3
1500m < LDA < 2400m	4
2400m < LDA	6



2.7. Runway Edge Marking

Runway edge markings are provided on ILS equipped runways and runways where the declared runway width is less than the paved width.





Runway edge markings consist of white lines along the runway edge.

3. Taxiway Markings

Taxiway markings are:

- Centre line
- Runway holding points
- Intermediate taxiway holding points
- Edge marking
- Closed cross for closed taxiways

All these taxiway markings are yellow.

Here are some examples of taxiway markings:

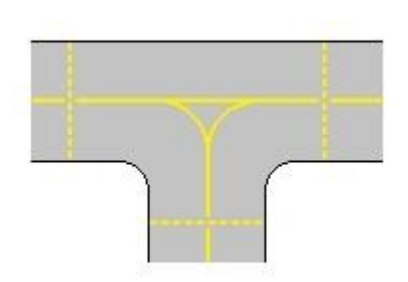
3.1. Taxiway edge markings

This indicates that beyond the marking the surface bearing strength is less than the taxiway, or the area is not intended for aircraft use



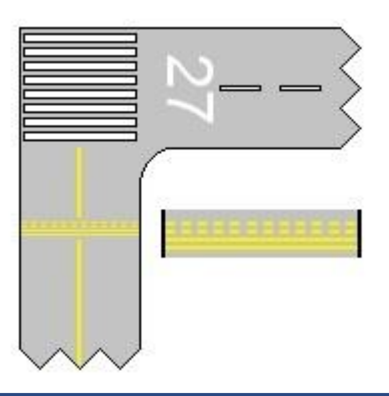
3.2. Intermediate taxiway holding point:

This indicates that the pilot shall take into account this intermediate crossing holding point to follow the air traffic controller instructions and to ensure the safety of nearby aircraft.



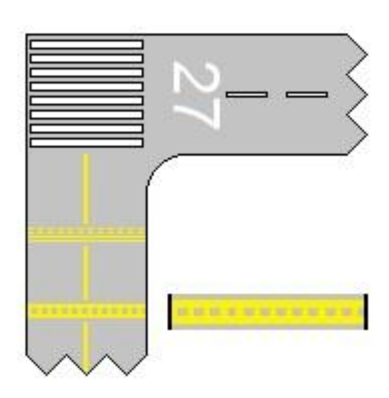
3.3. Runway holding point Pattern A

This marks the last holding point prior entering the runway.



3.4. Runway holding point Pattern B

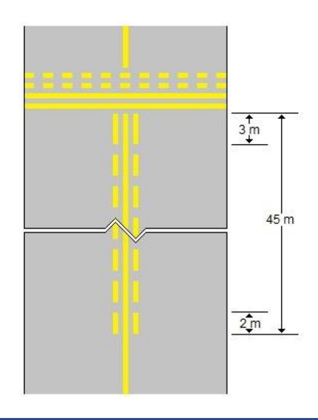
This marks a **CAT II/III holding point** where a closer holding point to the runway is provided.



3.5. Enhanced taxiway centerline

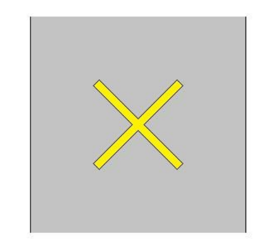
This may be provided, as part of measures against runway incursions.

Enhanced taxiway centreline marking extends from runway holding point Pattern A away from the runway for 45 meters, or the next runway holding point if this is located within 45 meters.



3.6. Yellow cross

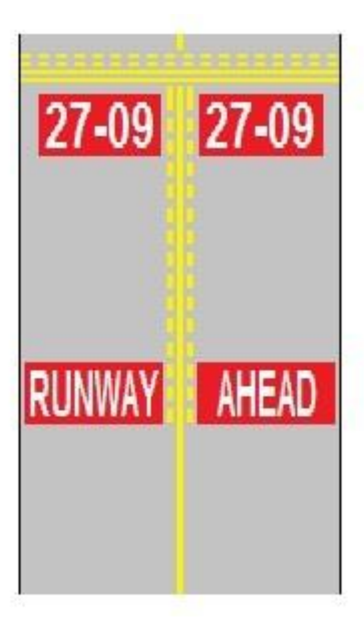
This indicates that the taxiway is unfit for the movement of aircraft. Taxi operations are forbidden.

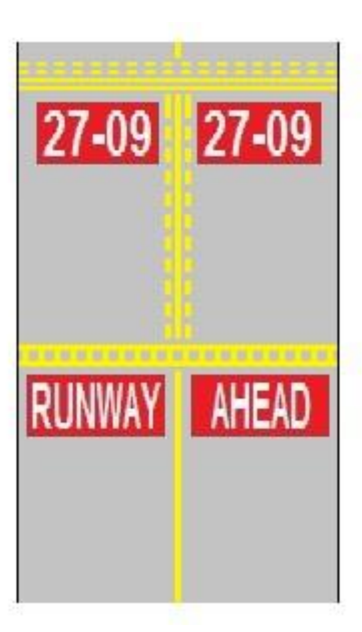


3.7. Mandatory instruction marking

Where it is impractical to place mandatory instruction signs, or as a supplement, **some mandatory instruction markings may be provided on taxiways**.

Mandatory instruction markings consist of a **red** background with a **white** inscription.



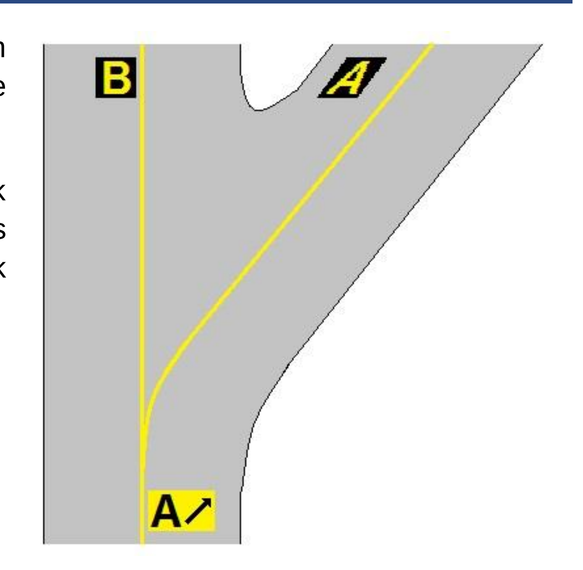


As the figure shows us, we can find the runway numbers and warning messages in order to **minimize runway incursions**.

3.8. Information marking

Where it is impractical to place Information signs, or just in addition to information signs, information markings may be provided.

Information markings indicating a location consist of a black background with a yellow inscription. Information markings indicating a direction consist of a yellow background with a black inscription.



4. Aerodrome signalization

In addition to taxiway marking signs, in airfields, you can find additional signalization close to the taxiways.

4.1. Mandatory Signs

Mandatory instruction signs indicate a location beyond which an aircraft shall not proceed without ATC clearance.

Mandatory instruction signs consist of a **red** background with a **white** inscription. They are located at runway holding points on both sides of the taxiway.

A 27 27 A	Indicates you are on taxiway "**A**", holding short of runway **27**.
B 27-09	Indicates you are on taxiway "**B**" holding short at an intersection of runway **09-27**. Where the threshold of runway **27** is on **your left**, and **09** on **your right**.
27 CAT II/III	Indicates the **CAT II/III holding point** for runway **27**.
B2	Indicates a holding position protecting a priority route.
	No entry sign.

At uncontrolled airports, all care must be taken before proceeding.
Mandatory instruction may be supplemented by location signs.

4.2. Information Signs

Information signs indicate either a location or a routing.

- Location signs consist of a **black** background with a yellow border and a yellow inscription.
- Direction signs consist of yellow background with a **black** inscription.

A	Indicating you are on taxiway **A**.
B →	Indicating taxiway **B** is the **next right**.
27 →	Indicating **runway 27** is on the **right**.
27 - 09 →	Indicating **reciprocal runways 27 and 09** are on the **right**.
27 • 24 →	Indicating **two different runways 27 and 24** are on the **right**.
2500 m →	Indicating the **TORA** from this intersection is **2500 meters**.

Information signs are usually located on the left side of the taxiway.
TORA = Take-off runway available distance



TERMINAL AERODROME FORECAST

1. Introduction

Basically, a **Terminal Aerodrome Forecast** (or Terminal Area Forecast, TAF) is a message with a defined format with the objective to report a weather **forecast** for a single airport and its vicinity.

This international code was developed by the ICAO and approved by the World Meteorological Organization. Baseline data are common to all countries, but some sections of the code are subject to local variations.

TAF messages are generally issued at every 6 hours and may have a validity of 12 hours, 24 hours or even 30 hours.

The TAF is made by a human forecaster (no automatic observation is done) and its structure is very close to the METAR (refer to the specific book), but some differences are noted and they'll be covered in this document.

2. Decoding (and understanding) the TAF

We'll use the following TAF as an example:

TAF SAEZ 171100Z 1712/1812 02005KT CAVOK TX22/1718Z TN11/1810Z
PROB40 TEMPO 1716/1718 4800 SHRA BKN020CB
BECMG 1801/1804 05005KT 7000 NSC
FM181000 02005KT 0800 BCFG=

2.1. Descriptor of the Message

TAF SAEZ 171100Z 1712/1812 02005KT CAVOK TX22/1718Z TN11/1810Z (...)

It informs that the message is a TAF.

2.2. Airfield ICAO Code

TAF **SAEZ** 171100Z 1712/1812 02005KT CAVOK TX22/1718Z TN11/1810Z (...)

It's the same as METAR. In the example, the forecast is issued for Buenos Aires/Ezeiza Airport (SAEZ).

2.3. Date and Time

TAF SAEZ **171100Z** 1712/1812 02005KT CAVOK TX22/1718Z TN11/1810Z (...)

It's the same as METAR. In the example, the forecast has been disseminated (published) at 1100Z of day 17.

Remember that the time is always in UTC.

2.4. Period of Validity

TAF SAEZ 171100Z **1712/1812** 02005KT CAVOK TX22/1718Z TN11/1810Z (...)

This group shows the period of the forecast's validity. **Before** the forward slash ("/") is the start of validity, while **after** the forward slash is the end of validity, showing **date and hour.** So, in the example, the forecast is valid between 1200Z of day 17 [**1712**] and 1200Z of day 18 [**1812**], comprising 24 hours.

2.5. Initial (or General) Forecast

TAF TXKF 171133Z 1712/1812 **02005KT CAVOK** TX22/1718Z TN11/1810Z (...)

This is the first thing we need to understand from the TAF. Since the weather is dynamic, a forecast may have **two** evolutions:

- **Temporary Change**
  The initial forecast changes **temporarily** in a certain timeframe, but will turn back to the initial forecast in the end of that timeframe
- **Definitive Change**
  The initial forecast changes **definitely**, gradually or does not. The initial forecast is not available anymore.

Some abbreviations are used to express a change, whether temporary or definitive. If no change is predicted in the forecast (not of any change keyword is mentioned), the initial forecast will be valid for the entire TAF duration, being a **General Forecast**.

In our example, the initial forecast (from 1200Z) is:

Wind: blowing from direction 020° with 5 knots of intensity;
Cloud Coverage and Visibility: no clouds and visibility equal or more than 10 km.

2.6. Maximum and Minimum Temperatures

TAF TXKF 171133Z 1712/1812 02005KT CAVOK **TX22/1718Z TN11/1810Z** (...)

The TAF also informs the atmospheric temperature range on that airport during the validity period of the TAF. The **maximum temperature** is indicated in **TX** group, while the **minimum temperature** is informed in **TN** group.
TX22/1718Z means that the **maximum** temperature expected for the TAF period is 22°C, to be observed on day 17 at 1800Z (date and time information like explained in section 2.4).
TN11/1810Z means that the **minimum** temperature expected for the TAF period is 11°C, to be observed on day 18 at 1000Z.

2.7. Probability

(...)
PROB40 TEMPO 1716/1718 4800 SHRA BKN020CB
BECMG 1801/1804 05005KT 7000 NSC
FM181000 02005KT 0800 BCFG=

If the meteorologist is not totally sure if a forecast change will happen, the percentage of probability of this change is informed with the abbreviation **PROB**. In the example, the probability of the forecast change (the underlined one) is 40% probable to happen.

A TAF will use PROB only for probability of 30% (**PROB30**) or 40% (**PROB40**).

2.8. Forecast Change

(...)
PROB40 **TEMPO 1716/1718** 4800 SHRA BKN020CB
BECMG 1801/1804 05005KT 7000 NSC
FM181000 02005KT 0800 BCFG=

If a change on forecast (with at least 50% of probability) is expected, it'll be informed accordingly. Resembling section 2.5 of this document, the abbreviations used for each change is:

Type of Change	Abbreviation Used	Meaning
Temporary	**TEMPO**	Temporary change between the specified period. After the end of the period, the weather will revert back to the state of the last definitive change.
Definitive	**FM**	**Immediate** change from a previous state to a new one from the date, time and minute specified to the described one, nullifying previous changes.
	BECMG	**Gradual** change from a previous state to a new one between the specified periods. After the end of the period, the weather will be the described one, nullifying previous changes.

In the example, we have three different changes:

2.8.1. Temporary Change (TEMPO)

PROB40 **TEMPO** **1716/1718** 4800 SHRA BKN020CB

Temporary Change (**TEMPO**) predicted between 1600Z of day 17 and 1800Z of day 17 to:

Visibility: 4800 m;
Weather Phenomenon: Moderate Shower Rain (SHRA);
Cloud coverage: Broken at 2000 ft AGL with cumulonimbus.
After 1800Z, the weather will **revert back** to the last state (original or motivated by BECMG/FM).

In our example, the last state is the original one: `02005KT CAVOK`

2.8.2. Definitive Gradual Change (BECMG)

BECMG **1801/1804** 05005KT 7000 NSC

Definitive Change (**BECMG**), **gradually** happening from 0100Z of day 17 to 0400Z of day 18. Weather will be changing to:

Wind: blowing from direction 050° with 5 knots of intensity;
Visibility: 7000 m;
Cloud coverage: Non-significative Clouds (NSC).
After 0400Z, the weather will be the described above, nullifying the last weather state.

2.8.3. Definitive Immediate Change (FM)

FM181000 02005KT 0800 BCFG=

Definitive Change (**FM**), **immediately** happening from 1000Z of day 18. Weather will change to:

Wind: blowing from direction 020° with 5 knots of intensity;
Visibility: 800 m;
Weather Phenomenon: Patches of Fog (BCFG).

2.9. End of message

FM181000 02005KT 0800 BCFG**=**

The equal sign (=) indicates the end of the message

To get a better understanding of the evolution of the weather states, look to the diagram of the next page.

Original Message:

TAF SAEZ 171100Z 1712/1812 02005KT CAVOK TX22/1718Z TN11/1810Z
PROB40 TEMPO 1716/1718 4800 SHRA BKN020CB
BECMG 1801/1804 05005KT 7000 NSC
FM181000 02005KT 0800 BCFG=

Weather Forecast evolution:

<table>
<tr><th>Period</th><th>Weather State</th></tr>
<tr><td>1200Z, day 17</td><td rowspan="4">Original State
02005KT CAVOK</td></tr>
<tr><td>1300Z, day 17</td></tr>
<tr><td>1400Z, day 17</td></tr>
<tr><td>1500Z, day 17</td></tr>
<tr><td>1600Z, day 17</td><td rowspan="2">Temporary Change (TEMPO) – Probability 40%
4800 SHRA BKN020CB</td></tr>
<tr><td>1700Z, day 17</td></tr>
<tr><td>1800Z, day 17
MAX TEMP – 22°C</td><td rowspan="7">Revert back to Original State
02005KT CAVOK</td></tr>
<tr><td>1900Z, day 17</td></tr>
<tr><td>2000Z, day 17</td></tr>
<tr><td>2100Z, day 17</td></tr>
<tr><td>2200Z, day 17</td></tr>
<tr><td>2300Z, day 17</td></tr>
<tr><td>2400Z, day 17</td></tr>
<tr><td>0100Z, day 18</td><td rowspan="3">Process of Gradual Change
BECMG</td></tr>
<tr><td>0200Z, day 18</td></tr>
<tr><td>0300Z, day 18</td></tr>
<tr><td>0400Z, day 18</td><td rowspan="6">State after the Gradual Change
05005KT 7000 NSC</td></tr>
<tr><td>0500Z, day 18</td></tr>
<tr><td>0600Z, day 18</td></tr>
<tr><td>0700Z, day 18</td></tr>
<tr><td>0800Z, day 18</td></tr>
<tr><td>0900Z, day 18</td></tr>
<tr><td>1000Z, day 18
MIN TEMP – 11°C</td><td rowspan="2">Immediate Change (FM)
02005KT 0800 BCFG</td></tr>
<tr><td>1100Z, day 18</td></tr>
</table>

3. More Examples

3.1. Example 1

TAF LEMD 171700Z 1718/1824 21010KT 9999 SCT030 TX27/1815Z TN15/1806Z
PROB30 TEMPO 1718/1722 3000 SHRA FEW030TCU
PROB40 TEMPO 1800/1809 VRB05KT BKN010=

TAF [**TAF**] for Madrid/Barajas Airport [**LEMD**] disseminated at 1700Z of day 17 [**171700Z**], valid between 1800Z of day 17 to 24Z of day 18 [**1718/1824**]. The initial forecast is: wind blowing from 210°, with 10 kt; visibility equal or more than 10 km, scattered clouds at 3000 ft AGL [**21010KT 9999 SCT030**]. The predicted maximum temperature is 27°C, for 1500Z of day 18 [**TX27/1815Z**]. The predicted minimum temperature is 15°C, for 0600Z of day 18 [**TN15/1806Z**].

The weather state will **temporarily** change, with 30% of probability [**PROB30**], between 1800Z and 2200Z of day 17 [**TEMPO 1718/1722**] to: visibility equal to 3000 m, moderate shower rain, few clouds at 3000 ft AGL with towering cumulus [**3000 SHRA FEW030TCU**]. After 2200Z, it'll revert back to initial state.

The weather state will **temporarily** change, with 40% of probability [**PROB40**], between 0000Z and 0900Z of day 18 [**TEMPO 1800/1809**] to: wind from variable direction, with 5 kt, broken clouds at 1000 ft AGL [**VRB05KT BKN010**]. After 0900Z, it'll revert back to initial state.

End of message [**=**].

3.2. Example 2

TAF VNKT 171500Z 1718/1818 00000KT 7000 FEW015 TX27/1807Z TN19/1722Z
BECMG 1800/1802 5000 BR
BECMG 1804/1805 20005KT 7000 FEW020 SCT100
BECMG 1807/1809 22010KT 9999
PROB40 TEMPO 1808/1814 FEW025CB BKN100
BECMG 1814/1815 00000KT 7000 FEW015 SCT100=

TAF [**TAF**] for Kathmandu Airport [**VNKT**] disseminated at 1500Z of day 17 [**171500Z**], valid between 1800Z of day 17 to 1800Z of day 18 [**1718/1818**]. The initial forecast is: wind calm, visibility equal to 7000 m, few clouds at 1500 ft AGL [**00000KT 7000 FEW015**]. The predicted maximum temperature is 27°C, for 0700Z of day 18 [**TX27/1807Z**]. The predicted minimum temperature is 19°C, for 2200Z of day 17 [**TN19/1722Z**].

The weather state will **gradually** change between 0000Z and 0200Z of day 18 [**BECMG 1800/1802**] to: visibility equal to 5000 m, mist [**5000 BR**]. After 0200Z, the change will complete and the initial state is withdrawn.

The weather state will **gradually** change between 0400Z and 0500Z of day 18 [**BECMG 1804/1805**] to: wind blowing from 200° with 5 kt, visibility equal to 4000 m, few clouds at 2000 ft AGL, scattered clouds at 10000 ft AGL [**20005KT 7000 FEW020 SCT100**]. After 0500Z, the change will complete and the preceding state is withdrawn.

The weather state will **gradually** change between 0700Z and 0900Z of day 18 [**BECMG 1807/1809**] to: wind blowing from 220° with 10 kt, visibility equal or bigger than 10 km [**22010KT 9999**]. After 0900Z, the change will complete and the preceding state is withdrawn.

The weather state will **temporarily** change, with 40% of probability [**PROB40**], between 0800Z and 1400Z of day 18 [**TEMPO 1808/1814**] to: few clouds at 2500 ft AGL with cumulonimbus, broken clouds at 10000 ft AGL [**FEW025CB BKN100**]. After 1400Z, it'll revert back to the **preceding** state.

The weather state will **gradually** change between 1400Z and 1500Z of day 18 [**BECMG 1814/1815**] to: wind calm, visibility equal to 7000 m, few clouds at 1500 ft AGL, scattered clouds at 10000 ft AGL [**00000KT 7000 FEW015 SCT100**]. After 1500Z, the change will complete and the preceding state is withdrawn.

End of message [**=**].

3.3. Example 3

TAF YSSY 171724Z 1718/1824 24015KT CAVOK
FM172300 21015KT CAVOK
FM180300 16010KT CAVOK
FM181000 24008KT 9999 SCT050=

TAF [**TAF**] for Sydney Airport [**YSSY**] disseminated at 1724Z of day 17 [**171724Z**], valid between 1800Z of day 17 to 2400Z of day 18 [**1718/1824**]. The initial forecast is: wind blowing from 240° with 15 kt, ceiling and visibility OK [**24015KT CAVOK**]. Maximum and Minimum temperatures weren't predicted.
The weather state will **immediately** change from 2300Z of day 17 [**FM172300**] to: wind blowing from 210° with 15 kt, ceiling and visibility OK [**21015KT CAVOK**].
The weather state will **immediately** change from 0300Z of day 18 [**FM180300**] to: wind blowing from 160° with 10 kt, ceiling and visibility OK [**16010KT CAVOK**].
The weather state will **immediately** change from 1000| of day 18 [**FM181000**] to: wind blowing from 240° with 8 kt, visibility equal or greater than 10 km, scattered clouds at 5000 ft AGL [**24008KT 9999 SCT050**].
End of message [**=**].

3.4. Example 4

KSEA 171728Z 1718/1824 33005KT P6SM VCSH SCT080 BKN120 BKN250
TEMPO 1718/1722 -SHRA
FM180600 20004KT P6SM -SHRA BKN060 OVC100
FM180900 20004KT P6SM -SHRA BKN040 OVC070=

TAF [**TAF**] for Seattle/Tacoma Airport [**KSEA**] disseminated at 1728Z of day 17 [**171724Z**], valid between 1800Z of day 17 to 2400Z of day 18 [**1718/1824**]. The initial forecast is: wind blowing from 330° with 5 kt, visibility greater than 6 statute miles, showers in the vicinity of the aerodrome, scattered at 8000 ft AGL, broken at 12000 ft AGL, broken at 25000 ft AGL [**33005KT P6SM VCSH SCT080 BKN120 BKN250**]. Maximum and Minimum temperatures weren't predicted.
The weather state will **temporarily** change between 1800Z and 2200Z of day 17 [**TEMPO 1718/1722**] to: light shower rain [**-SHRA**]. After 2200Z, it'll revert back to the **original** state.
The weather state will **immediately** change from 0600Z of day 18 [**FM180600**] to: wind blowing from 200° with 4 kt, visibility greater than 6 statute miles, light shower rain, broken at 6000 ft AGL, overcast at 10000 ft AGL [**20004KT P6SM -SHRA BKN060 OVC100**].
The weather state will **immediately** change from 0900Z of day 18 [**FM180900**] to: wind blowing from 200° with 4 kt, visibility greater than 6 statute miles, light shower rain, broken at 4000 ft AGL, overcast at 7000 ft AGL [**20004KT P6SM -SHRA BKN040 OVC070**].
End of message [**=**].



SIGMET

1. Introduction

A SIGMET (Significant Meteorological Information) is a meteorological report issued by a meteorological watch office that gives a description in abbreviated plain language of the occurrence and/or expected occurrence of specified en-route weather phenomena, which may affect the safety of aircraft operations and the development of those phenomena in time and space.

They are issued with a maximum duration of 4 hours (if the message is for Volcanic Ash cloud and/or Tropical Cyclones, the max duration is 6 hours) and shall be cancelled by another message when the phenomenon is not observed anymore or has changed significantly.

Usually, SIGMETs are issued for observations/forecasts occurring above FL100, while the information below that level is covered by AIRMETs (Airmen's Meteorological Information).

2. Types of SIGMET

Per ICAO definition, there are three types of SIGMET:

- SIGMET for Volcanic Ash (**VA SIGMET** or **WV SIGMET**);
- SIGMET for Tropical Cyclone (**TC SIGMET**);
- SIGMET for any other en-route weather phenomena except Volcanic Ash and Tropical Cyclone (which may be Thunderstorms [TS], Turbulence [TURB], Icing [ICE], Mountain Waves [MTW], Dust Storm [DS], Sand Storm [SS] or Radioactive Cloud [RDOACT CLD]) (**WS SIGMET**).

The type of the message is identified in its header.

3. Structure of a SIGMET

Let's use this SIGMET as an example:

WSBZ21 SBRE 150430
SBAO SIGMET 1 VALID 150435/150835 SBRE-
SBAO ATLANTIC FIR EMBD TS FCST AT 0435Z WI S3154 W04804 - S3400 W05000 - S3400 W04625 - S3154 W04804 TOP FL380 MOV NE 05KT NC=

3.1. Header

The header of the SIGMET message contains the type of the message, issuing country or territory, bulletin number, creator of the message (generally the FIR where the observation/forecast is in) and the date/time of the dissemination of the message.

In our example:

- **WSBZ21**
  - ⊗ **WS** indicates that the message is a SIGMET for any en-route phenomena. In case of a SIGMET for Volcanic Ash, it shall be **WV** and for a SIGMET for Tropical Cyclone, **WC**.
  - ⊗ **BZ** is the indication of the country where the message came from. In our example, Brazil;
  - ⊗ **21** is the bulletin number, assigned in the national level. It's not so relevant for our simulation.
- **SBRE** is the FIR that *disseminated* the message. In this case, the **Recife FIR**;
- **150430** is the date and time of the dissemination of the message. The first two digits is the date and the last four digits, the Zulu time (hour and minute). In this case, this example message was disseminated on day **15**, at **0430Z**.

A list of available codes and corresponding countries is available in Appendix 1 of this document.

3.2. First Line

The first line of the SIGMET message contains the referred area of the observation/forecast (or where the observation/forecast is issued to), the identifier and daily sequence number, the period of validity (beginning and ending) and the station that made the observation/forecast which originated the message.

In our example:

- **SBAO** is where the observation/forecast where the SIGMET is issued to. In this case, the **Atlantic FIR**;
- **SIGMET 1** is the type of the message and the sequential number of the day;
- **VALID 150435/150835** is the period of validity of the message. It follows the same standard of the date/time of the header. In this case, it means that the message is valid between 0435Z of day 15 and 0835Z of day 15;
- **SBRE-** is the station which did the observation/forecast, As a coincidence, it's the same one that disseminated the message (per info in the header). The hyphen is the signal to separate the preamble of the message from its text).

3.3. Second Line

The second line is the meteorological part of the SIGMET. It contains nine elements, as shown below:

1) **Location indicator of FIR(/UIR) or CTA**;
2) **Name of the FIR(/UIR) or CTA;**
3) **Description of the phenomenon;**
4) **Observed or Forecasted;**
5) **Location of observation/forecast;**
6) **Level (altitude) of the observation/forecast;**
7) **Movement or Expected Movement;**
8) **Changes in intensity;**
9) **Forecasted position at end of SIGMET's end of validity (optional).**

In our example:

- **SBAO ATLANTIC FIR** is the Location Indicator and the Name of the FIR that holds the element of observation/forecast. That is, the element of weather report is located inside the SBAO FIR;
- **EMBD TS** is the description of the observed/forecasted phenomenon. In the example, **Embedded Thunderstorms**.
- **FCST AT 0435Z** means the information is a **forecast**. If **OBS** was written, it means that the information is an **observation**. When the information does not come with a time information, it means the exact time of observation/forecast is not known;
- **WI S3154 W04804 - S3400 W05000 - S3400 W04625 - S3154 W04804** is the location of the forecast. When **WI** (**Within**) is stated, it means that the observation is *INSIDE* that polygon created by the geographic coordinates;
- **TOP FL380** is the altitude of observation. It may be a specific flight level (**FLxxx**), a layer (**FLxxx/yyy**) or the indication of its top (**TOP FLxxx**)**.** If an exact flight level cannot be defined, the use of terms **ABV** (Above) or **BLW** (Below) can be used. In our example, the top of those Embedded Thunderstorms inside the polygon above reaches the FL380;
- **MOV NE 05KT** indicates that the centre of the cloud mass is moving *NORTHEAST* at the speed of 5 knots (nm/h). If the abbreviation **STNR** is indicated, it means that the phenomenon is stationary;
- **NC** indicates that there's *no change* in the intensity of the phenomenon. If the phenomenon is becoming stronger, the term **INTSF** (Intensifying) is used. Else, if the phenomenon is becoming weaker, the term **WKN** (Weakening) is used;
- The equal sign (**=**) indicates the end of message.

Note that only the following phenomena are allowed for a SIGMET:
Thunderstorms – if they are **Obscure/Obscuring/Obscured** (OBSC), **Embedded** (in layer) (EMBD), **Frequent** (FRQ) or arranged in a **Squall Line** (SQL), with or without hail;
Turbulence – only Severe (SEV);
Icing – only **Severe** (SEV), with or without **Freezing Rain** (FZRA);
Mountain Waves - only Severe (SEV);
Dust Storm – only Heavy (HVY);
Sand Storm – only Heavy (HVY);
Radioactive Cloud.

4. Tropical Cyclone SIGMET (TC SIGMET)

Let's see the example of a TC SIGMET, with a little different structure:

```
WCMX31 MMMX 150924
MMEX SIGMET 2 VALID 150918/151518 MMMX-
MMFR MEXICO FIR TC ODILE OBS N2342 W11024 AT 0918Z
FRQ TS TOP FL520 WI 180NM OF CENTRE
MOV NNW 14KT WKN.
FCST TC CENTRE 151500 N2436 W11112=
```

The interpretation:

```
WCMX31 MMMX 150924
(...)
```

SIGMET for Tropical Cyclone (WC) at Mexico (MX) [**WCMX31**]. Message disseminated by MMMX [**MMMX**] at 0924Z of day 15 [**150924**].

```
(...)
MMEX SIGMET 2 VALID 150918/151518 MMMX-
(...)
```

The SIGMET message was issued to MMEX FIR, being the 2nd message of the day for that FIR [**MMEX SIGMET 2**]. It's valid between 0918Z of day 15 and 1518Z of day 15 [**VALID 150918/151518**]. The observation was done by MMMX station. End of preamble [**MMMX-**].

```
(...)
MMFR MEXICO FIR TC ODILE OBS N2342 W11024 AT 0918Z
FRQ TS TOP FL520 WI 180NM OF CENTRE
MOV NNW 14KT WKN.
FCST TC CENTRE 151500 N2436 W11112=
```

The observation was done inside MMFR (Mexico FIR) [**MMFR MEXICO FIR**]. The element of the observation is the Tropical Cyclone named 'Odile' [**TC ODILE**], with centre observed [**OBS**] at the position 23°42'N 110°24'W [**N2342 W11024**]. The observation was done at 0918Z [**0918Z**].

Frequent Thunderstorms [**FRQ TRS**] topped at FL520 [**TOP FL520**] within 180 nm of the cyclone's centre [**WI 180NM OF CENTRE**] are observed.

The cyclone is moving to north-northwest direction at the speed of 14 knots [**MOV NNW 14KT**], becoming weaker [**WKN**].

The station also forecasts the cyclone's centre [**FCST TC CENTRE**] at 1500Z of day 15 [**151500**] to be 24°36'N 111°12'W [**N2436 W11112**].

End of message [**=**].

5. Volcanic Ash SIGMET (VA SIGMET/WV SIGMET)

Let's see the example of a VA SIGMET, with a little different structure:

```
WVID21 WAAA 151012
WAAF SIGMET A03 VALID 151230/151830 WAAA-
WAAF UJUNG PANDANG FIR VA ERUPTION
MT DUKONO PSN N0141 E12753 VA CLD
VA CLD OBS AT 151230Z
WI N0140 E12755 – N0210 E12725 - N0150 E12710 – N0140 E12755 SFC/FL070
MOV NW 10KT
FCST 1830Z
WI N0140 E12755 – N0140 E12755 - N0210 E12725 – N0150 E12710 – N0140 E12755 SFC/FL070=
```

The interpretation:

```
WVID21 WAAA 151012
(...)
```

SIGMET for Volcanic Ash (WV) at Indonesia (ID) [**WVID21**]. Message disseminated by WAAA [**WAAA**] at 1012Z of day 15 [**151012**].

```
(...)
WAAF SIGMET A03 VALID 151230/151830 WAAA-
(...)
```

The SIGMET message was issued to WAAF FIR, being the message sequenced as A03 of the day for that FIR [**WAAF SIGMET A03**]. It's valid between 1230Z of day 15 and 1830Z of day 15 [**VALID 151230/151830**]. The observation was done by WAAA station. End of preamble [**WAAA-**].

```
(...)
WAAF UJUNG PANDANG FIR VA ERUPTION
MT DUKONO PSN N0141 E12753 VA CLD
VA CLD OBS AT 15/1230Z
(...)
```

The observation was done inside WAAF (Ujung Pandang FIR) [**WAAF UJUNG PANDANG FIR**]. The element of the observation is a Volcanic Eruption [**VA ERUPTION**] from Mountain Dukono [**MT DUKONO**], which is located at position 01°41'N 127°53'E [**PSN N0141 E12753**]. A Volcanic Ash Cloud [**VA CLD**] was observed at 1230Z of day 15 [**OBS AT 151230Z**]. End of this section [**VA CLD**].

```
(...)
WI N0140 E12755 – N0210 E12725 - N0150 E12710 – N0140 E12755 SFC/FL070
MOV NW 10KT
(...)
```

The Volcanic Ash Cloud is located within the polygon delimited by the quoted points [**WI N0140 E12755 – N0210 E12725 - N0150 E12710 – N0140 E12755**], observed from surface to FL070 [**SFC/FL070**].

The mass of cloud is moving *NORTHWEST*, with the speed of 10 knots [**MOV NW 10KT**].

```
(...)
FCST 1830Z
```

WI N0140 E12755 – N0140 E12755 - N0210 E12725 – N0150 E12710 – N0140 E12755 SFC/FL070=

At 1830Z, the mass of VA Cloud is forecasted [**FCST 1830Z**] to be within the polygon delimited by the quoted points [**N0140 E12755 – N0140 E12755 - N0210 E12725 – N0150 E12710 – N0140 E12755**], observed from surface to FL070 [**SFC/FL070**].

End of message [**=**].

6. Cancellation of a SIGMET

If, during the validity period of a SIGMET, the phenomenon for which the SIGMET had been issued is no longer occurring or no longer expected, or if the observation/forecast has changed significantly from the original message, this SIGMET should be cancelled by the same organ that issued it by issuing another SIGMET, overriding the older one.

The structure is the following one:

WSQB31 LDZM 151306
LQSB SIGMET W4 VALID 151306/151500 LDZA-
LQSB SARAJEVO W UIR AND SARAJEVO FIR CNL SIGMET W3 151300/151500=

Which needs to be interpreted like:

WSQB31 LDZM 151306
(...)

SIGMET for Enroute Phenomenon (WS) at Bosnia and Herzegovina (QB) [**WSQB31**]. Message disseminated by LDZM [**LDZM**] at 1306Z of day 15 [**151306**].

(...)
LQSB SIGMET W4 VALID 151306/151500 LDZA-
(...)

The SIGMET message was issued to LQSB FIR, being the message sequenced as W4 of the day for that FIR [**LQSB SIGMET W4**]. It's valid between 1306Z of day 15 and 1500Z of day 15 [**VALID 151306/151500**]. The observation was done by LDZA station. End of preamble [**LDZA-**].

(...)
LQSB SARAJEVO W UIR AND SARAJEVO FIR CNL SIGMET W3 151300/151500=

The observation was done inside LQSB (Sarajevo FIR/UIR) [**LQSB SARAJEVO W UIR AND SARAJEVO FIR**]. The instruction is to *CANCEL* the SIGMET message W3 (number of sequence) [**CNL SIGMET W3**], which was valid from 1300Z of day 15 to 1500Z of day 15 [**151300/151500**].

End of message [**=**].

7. Other examples

Some examples for better understanding.

```
WSCH31 SCCI 151704
SCCZ SIGMET 1 VALID 151704/152104 SCCI-
SCCZ PUNTA ARENAS FIR SEV ICE FCST S OF S54 N OF S57 E OF W77 BTN FL040/FL150=
```

SIGMET for Enroute Phenomenon (WS) at Chile (CH) [**WSCH31**]. Message disseminated by SCCI [**SCCI**] at 1704Z of day 15 [**151704**]. The SIGMET message was issued to SCCZ FIR, being the message sequenced as 1 of the day for that FIR [**SCCZ SIGMET 1**]. It's valid between 1704Z of day 15 and 2104Z of day 15 [**VALID 151704/152104**]. The observation was done by SCCI station. End of preamble [**SCCI-**]. The observation was done inside SCCZ (Punta Arenas FIR) [**SCCZ PUNTA AERINAS FIR**]. Severe Icing is forecasted [**SEV ICE FCST**] at the area located *SOUTH* of latitude 54°S [**S OF S54**], *NORTH* of latitude 57°S [**N OF S57**] and *EAST* of longitude 77°W [**E OF W77**], between FL040 and FL150 [**BTN FL040/FL150**]. End of message [**=**].

```
WSCI35 ZJHK 151736
ZJSA SIGMET 7 VALID 151745/152145 ZJHK-
ZJSA SANYA FIR FRQ TS FCST S OF N2018 TOP FL450 MOV NW 30KMH INTSF=
```

SIGMET for Enroute Phenomenon (WS) at China (CI) [**WSCI35**]. Message disseminated by ZJHK [**ZJHK**] at 1736Z of day 15 [**151736**]. The SIGMET message was issued to ZJSA FIR, being the message sequenced as 7 of the day for that FIR [**ZJSA SIGMET 7**]. It's valid between 1745Z of day 15 and 2145Z of day 15 [**VALID 151745/152145**]. The observation was done by ZJHK station. End of preamble [**ZJHK-**]. The observation was done inside ZJSA (Sanya FIR) [**ZJSA SANYA FIR**]. Frequent Thunderstorm is forecasted [**FRQ TS FCST**] at the area located *SOUTH* of latitude 20°18'N [**S OF N2018**]. The top of the cloud mass is located at FL450 [**TOP FL450**]. The formation is moving to *NORTHWEST* at the speed of 30 km/h [**MOV NW 30KMH**] and it's intensifying [**INTSF**]. End of message [**=**].

```
WSRS37 RUAA 151657
ULAM SIGMET 1 VALID 151800/152200 ULAA-
ULAM NARYAN-MAR FIR SEV TURB FCST FL260/370 MOV SE 45 KMH NC=
```

SIGMET for Enroute Phenomenon (WS) at Russia (RS) [**WSRS37**]. Message disseminated by RUAA [**RUAA**] at 1657Z of day 15 [**151657**]. The SIGMET message was issued to ULAM FIR, being the message sequenced as 1 of the day for that FIR [**ULAM SIGMET 1**]. It's valid between 1800Z of day 15 and 2200Z of day 15 [**VALID 151800/152200**]. The observation was done by ULAA station. End of preamble [**ULAA-**]. The observation was done inside ULAM (Naryan-Mar FIR) [**ULAM NARYAN-MAR FIR**]. Severe Turbulence is forecasted [**SEV TURB FCST**] between the levels 260 and 370 [**TOP FL450**]. The turbulence area is moving to *SOUTHEAST* at the speed of 45 km/h [**MOV SE 45KMH**] with no changes in its strength [**NC**]. End of message [**=**].

Appendix 1 – List of Geographical Designators for SIGMET Header

AB	Albania	GU	Guatemala	NV	Vanuatu
AG	Argentina	GW	Guinea-Bissau	NW	Nauru
AH	Afghanistan	GY	Guyana	NZ	New Zealand
AI	Ascension Island	HA	Haiti	OM	Oman
AJ	Azerbaijan	HE	Saint Helena	OR	South Orkney Islands
AK	Alaska	HK	Hong Kong, China	OS	Austria
AL	Algeria	HO	Honduras	PF	French Polynesia
AN	Angola	HU	Hungary	PH	Philippines
AT	Antigua and Barbuda, Saint Kitts and Nevis and other British islands in the vicinity	HV	Burkina Faso	PI	Phoenix Islands
AU	Australia	HW	Hawaiian Islands	PK	Pakistan
AY	Armenia	IC	Comoros	PL	Poland
AZ	Azores	ID	Indonesia	PM	Panama
BA	Bahamas	IE	Ireland	PO	Portugal
BC	Botswana	IL	Iceland	PR	Peru
BD	Brunei Darussalam	IN	India	PT	Pitcairn
BE	Bermuda	IQ	Iraq	PU	Puerto Rico
BH	Belize	IR	Islamic Republic of Iran	PY	Paraguay
BI	Burundi	IS	Israel	QB	Bosnia and Herzegovina
BJ	Benin	IV	Côte d'Ivoire	QT	Qatar
BK	Banks Islands	IY	Italy	RA	Russian Federation (East)
BM	Myanmar	JD	Jordan	RE	Réunion and associated islands
BN	Bahrain	JM	Jamaica	RH	Croatia
BO	Bolivia	JP	Japan	RM	Republic of Moldova
BR	Barbados	KA	Caroline Islands	RO	Romania
BU	Bulgaria	KB	Kiribati	RS	Russian Federation (West)
BV	Bouvet Island	KI	Christmas Island	RW	Rwanda
BW	Bangladesh	KK	Cocos Islands	SB	Sri Lanka
BX	Belgium, Luxembourg	KN	Kenya	SC	Seychelles
BY	Belarus	KO	Republic of Korea	SD	Saudi Arabia

BZ	Brazil	KP	Cambodia	SG	Senegal
CD	Chad	KR	Democratic People's Republic of Korea	SI	Somalia
CE	Central African Republic	KU	Cook Islands	SK	Sarawak
CG	Congo	KW	Kuwait	SL	Sierra Leone
CH	Chile	KY	Kyrgyzstan	SM	Suriname
CI	China	KZ	Kazakhstan	SN	Sweden
CM	Cameroon	LA	Lao People's Democratic Republic	SO	Solomon Islands
CN	Canada	LB	Lebanon	SP	Spain
CO	Colombia	LC	Saint Lucia	SQ	Slovakia
CR	Canary Islands (Spain)	LI	Liberia	SR	Singapore
CS	Costa Rica	LJ	Slovenia	SU	Sudan
CT	Canton Island	LN	Southern Line Islands	SV	Swaziland
CU	Cuba	LS	Lesotho	SW	Switzerland
CV	Cape Verde	LT	Lithuania	SX	Santa Cruz Islands
CY	Cyprus	LV	Latvia	SY	Syrian Arab Republic
CZ	Czech Republic	LY	Libyan Arab Jamahiriya	SZ	Spitzbergen Islands
DJ	Djibouti	MA	Mauritius	TA	Tajikistan
DL	Germany	MB	Marion Island	TC	Tristan da Cunha
DN	Denmark	MC	Morocco	TD	Trinidad and Tobago
DO	Dominica	MD	Madeira	TG	Togo
DR	Dominican Republic	MF	Saint-Martin, Saint-Barthélemy, Guadeloupe and other French islands in the vicinity	TH	Thailand
EG	Egypt	MG	Madagascar	TI	Turks and Caicos Islands
EO	Estonia	MH	Marshall Islands	TK	Tokelau
EQ	Ecuador	MI	Mali	TM	Timor-Leste
ER	United Arab Emirates	MJ	The former Yugoslav Republic of Macedonia	TN	United Republic of Tanzania
ES	El Salvador	MK	Montenegro	TO	Tonga
ET	Ethiopia	ML	Malta	TP	Sao Tome and Principe
FA	Faroe Islands	MN	St Maarten, St Eustatius and Saba	TR	Turkmenistan
FG	French Guiana	MO	Mongolia	TS	Tunisia

FI	Finland	MR	Martinique	TU	Turkey
FJ	Fiji	MS	Malaysia	TV	Tuvalu
FK	Falkland Islands (Malvinas)	MT	Mauritania	UG	Uganda
FP	Saint Pierre and Miquelon	MU	Macao, China	UK	United Kingdom of Great Britain and Northern Ireland
FR	France	MV	Maldives	UR	Ukraine
FW	Wallis and Futuna	MW	Malawi	US	United States of America
GB	Gambia	MX	Mexico	UY	Uruguay
GC	Cayman Islands	MY	Mariana Islands	UZ	Uzbekistan
GD	Grenada	MZ	Mozambique	VG	Saint Vincent and the Grenadines
GE	Gough Island	NC	New Caledonia	VI	Virgin Islands
GG	Georgia	NG	Papua New Guinea	VN	Venezuela
GH	Ghana	NI	Nigeria	VS	Viet Nam
GI	Gibraltar	NK	Nicaragua	YE	Yemen
GL	Greenland	NL	Netherlands	YG	Serbia
GM	Guam	NM	Namibia	ZA	South Africa
GN	Guinea	NO	Norway	ZB	Zambia
GO	Gabon	NP	Nepal	ZM	Samoa
GQ	Equatorial Guinea	NR	Niger	ZR	Democratic Republic of the Congo
GR	Greece	NU	Netherlands Antilles (Bonaire, Curacao) and Aruba	ZW	Zimbabwe

Appendix 2 – List of abbreviations that can appear in a SIGMET

ABV	Above	HZ	Haze	SA	Sand
AIRMET	AIRMET Information	IC	Ice crystals	SE	South-east
AND*	And	ICE	Icing	SEV	Severe (used e.g. to qualify icing and turbulence reports)
APRX	Approximate or approximately	INTSF	Intensify or intensifying	SFC	Surface
AT	At (followed by time)	ISOL	Isolated	SG	Snow grains
BKN	Broken	KM	Kilometres	SIGMET	Information concerning en-route weather phenomena which may affect the safety of aircraft operations

BR	Mist	KMH	Kilometres per hour	SN	Snow
BY*	By	KT	Knots	SQ	Squalls
CB	Cumulonimbus	LINE	Line	SQL	Squall line
CENTRE*	Centre (used to indicate tropical cyclone centre)	MPS	Metres per second	SS	Sandstorm
CLD	Cloud	MOD	Moderate (used to indicate intensity of weather phenomena)	SSE	South-Southeast
CNL	Cancel or cancelled	MOV	Move or moving or movement	SSW	South-Southwest
CTA	Control area	MT	Mountain	STNR	Stationary
DS	Duststorm	MTW	Mountain waves	SW	South-west
DU	Dust	N	North or northern latitude	TC	Tropical cyclone (not required in the EUR Region)
DZ	Drizzle	NC	No change	TCU	Towering Cumulus
E	East or eastern longitude	NE	North-east	TO	To … (place)
EMBD	Embedded in layer (to indicate CB embedded in layers of other clouds)	NM	Nautical miles	TOP	Cloud top
ENE	East-Northeast	NNE	North-Northeast	TS	Thunderstorm
ERUPTION*	Eruption (used to indicate volcanic eruption)	NNW	North-Northwest	TSGR	Thunderstorm with hail
ESE	East-Southeast	NW	North-west	TURB	Turbulence
EXP	Expected	OBS	Observe or observed or observation	UIR	Upper flight information region
FCST	Forecast	OBSC	Obscure or obscured or obscuring	VA	Volcanic ash
FG	Fog	OCNL	Occasional or occasionally	VALID*	Valid
FIR	Flight information region (link to global FIR map: http://gis.icao.int/flexviewer/)	OF*	Of … (place)	VIS	Visibility
FL	Flight level	OVC	Overcast	W	West or western longitude
FRQ	Frequent	PL	Ice pellets	WSPD	Wind speed
FU	Smoke	PO	Dust/sand whirls	WI	Within
FZRA	Freezing rain	PSN	Position	WID	Width
GR	Hail	RA	Rain	WNW	West-Northwest
GS	Small hail and/or snow pellets	RDOACT*	Radioactive	WSW	West-Southwest
HVY	Heavy (used to indicate intensity of weather phenomena)	S	South or southern latitude	Z	Coordinated Universal Time (used in meteorological messages)

**not in the ICAO Doc 8400, ICAO Abbreviations and Codes, but used in SIGMET messages*



VFR PHRASEOLOGY

1. Introduction

1.1. What is phraseology?

Phraseology is the way to communicate between the pilot and air traffic controller.
This way is stereotyped and you shall not invent new words.

As a pilot, you must repeat the air traffic controller clearances you received.
That is called the read back procedure.

It is a mandatory procedure except when the pilot is in emergency and he has no time to read back or when the pilot's radio is broken.

1.2. Basic Rules

An ATC must start all messages with the call sign of the destination aircraft.
A pilot usually ends all messages with his call sign (especially for read-back).

The following words may be omitted from transmissions provided that no confusion or ambiguity will result:

- "Surface" in relation to surface wind direction and speed
- "Degrees" in relation to radar headings
- "Visibility", "Clouds" and "Height" in meteorological reports
- "Hecto Pascal" when giving pressure settings

The use of courtesies should be avoided.

The word "IMMEDIATELY" should only be used when immediate action is required for safety reasons.

1.3. Advice for VFR pilots

If any traffic controller is in charge of your airfield, as a VFR pilot, **you must read his ATIS** (Automatic Terminal Information Service) which contains basic elements as:

- Weather information (METAR) including QNH value
- Runway in use
- Transition altitude / transition flight level
- Other information applicable for your VFR flight (if present)
- Information letter

You must check the weather using METAR and TAF information of the airfield, or a nearby one if your airfield has no weather station.

1.4. Information

In this document, we use the following convention:

- VFR Pilot call sign is **F-GLRA**. Short pilot call sign can be used as **F-RA** by ATC.
- ATC position is located at **Faircity** airfield.
- The sign ✈ before the text means that it is the pilot sentence.
- The sign 🕴 before the text means that it is the ATC sentence.

The ATC is the one that may start using the short call sign. Only thereafter the pilot shall use it as well.

2. Transmitting technique

The following transmitting techniques will assist in ensuring that transmitted speech is clear and satisfactorily received:

1. before transmitting, listen out on the frequency to be used to ensure that there will be no interference with a transmission from another station
2. use a normal conversational tone, and speak clearly and distinctly
3. maintain the speaking volume at a constant level
4. a slight pause before and after numbers will assist in making them easier to understand
5. avoid using hesitation sounds such as "er"
6. be familiar with the microphone operating techniques, particularly in relation to the maintenance of a constant distance from the microphone
7. depress the transmit switch fully before speaking and do not release it until the message is completed

We give you a specific advice for using the IVAO voice server. After switching to a new channel using the voice server, be aware that you never hear the current speaking person.
Always wait 3/5 seconds minimum, before transmitting your message.

3. Delivering the VFR clearance and taxi

3.1. Outbound flight with no restrictions

Pilot ✈	**ATC** 🕴
✈🔈 F-GLRA, Cessna C172, at the general aviation apron, with information **Delta**, request taxi for VFR flight destination HighVilla	
	🕴🔈F-RA, squawk 7006, taxi holding point runway 23 via taxiway Alpha
✈🔈 squawk 7006, taxiing holding point runway 23 via taxiway Alpha, F-RA	

When the VFR pilot approaches the holding point of the active runway:

Pilot	ATC
holding point runway 23, ready for departure F-RA	
	F-RA, contact Faircity Tower, 118.3
Contact Faircity Tower, 118.3	

3.2. Outbound flight with a VFR departure published

Pilot	ATC
F-GLRA, Cessna C172, at the general aviation apron, with information **Delta**, request taxi for VFR flight destination HighVilla	
	F-RA, exit via SE3 departure, squawk 7006, taxi holding point runway 23 via taxiway Alpha
Exit via SE3 departure, squawk 7006, taxiing holding point runway 23 via taxiway Alpha, F-RA	

When the VFR pilot approaches the holding point of the active runway:

Pilot	ATC
holding point runway 23, ready for departure F-RA	
	F-RA, contact Faircity Tower, 118.3
Contact Faircity Tower, 118.3	

Note: the VFR departure route in the example is SE3.
You can replace SE3 Departure with a simple exit point like SE. It depends on your local regulations and published procedures.

3.3. Flight for aerodrome circuit pattern

Pilot	ATC
F-RA, Cessna C172, at the general aviation apron, with information Delta, request taxi for circuit patterns	
	F-RA, squawk 7006, taxi holding point runway 23
squawk 7006, taxi holding point runway 23, F-RA	

Note: ATC can give the circuit parameters in the clearance. Parameters are left/right hand pattern, altitude to maintain, any specific restrictions to follow.

Pilot	ATC
	F-RA, right hand pattern, 1400 feet, squawk 7006, taxi holding point runway 23.
right hand pattern, 1400 feet, squawk 7006, taxi holding point runway 23, F-RA	

3.4. Helicopter taxi

Many helicopters cannot taxi on their wheels. The helicopter taxi procedure is to fly some meter high over the ground surface (taxi, apron, grass…) to the destination point.
The term "air-taxi" shall be used" in place of "taxi".

Pilot	ATC
F-RA, Bell Helicopter, at the general aviation apron, with information Delta, request air-taxi to the fuel station	
	F-RA, air-taxi to the fuel station.
air-taxi to the fuel station, F-RA	

4. Line-up and Taking off

Controllers should not transmit to an aircraft during take-off, initial climb, the last part of the final approach or the landing roll, unless it is necessary for safety reasons, as it may be distracting to the pilot at a time when the cockpit workload is at its highest.

4.1. Take-off after a line up

Pilot	ATC
F-RA, Faircity Tower, holding point runway 23, ready for departure	
	F-RA, line-up runway 23 and wait.
Line-up runway 23 and wait, F-RA	
(after a moment)	
	F-RA runway 23, cleared for take-off, wind 110 degrees 8 knots
Runway 23, cleared for take-off, F-RA	

4.2. Direct take-off with a report over VFR point

Pilot	ATC
F-RA, Faircity Tower, holding point runway 23, ready for departure	
	F-RA, report over **SE**, runway 23, cleared for take-off, wind 110 degrees 8 knots
will report over SE, Runway 23, cleared for take-off, F-RA	

4.3. Other position reports

<u>For circuit patterns:</u>

Pilot	ATC
	F-RA, report left hand downwind, runway 23, cleared for take-off, wind 110 degrees, 8 knots
Will report left hand downwind, Runway 23, cleared for take-off, , F-RA	

For an exercise requiring to fly over airfield:

Pilot	**ATC**
Faircity Tower, hello, holding point A runway 23, F-RA	
	F-RA, report over airfield, 2000ft, line-up runway 23, cleared for take-off, wind 270 degrees 10 knots
Will report over airfield 2000ft, Runway 23 cleared for take-off, F-RA	

5. Level instructions

Levels instructions may be reported as altitude, height or flight levels according to the phase of flight and the altimeter setting.

5.1. Reported flight level requested by ATC

Pilot	**ATC**
	F-RA**,** report passing 1500 feet
F-RA, Wilco	
	(after some time)
F-RA, passing 1500 feet	

5.2. Level change

Pilot	**ATC**
	F-RA**,** climb to 2000ft
climbing to 2000ft, F-RA	

Pilot	**ATC**
	F-RA**,** descend to 1200 feet
descending to 1200 feet, F-RA	

Level change using conditional clearance:

Pilot	**ATC**
	F-RA**,** after passing NCS NDB, descend to 1500 feet
after NCS NDB, descend to 1500 feet, F-RA	

Once having been given an instruction to climb or descend, a further overriding instruction may be given to a pilot:

Pilot	**ATC**
	F-RA**,** continue climb 3000 feet
climbing to 3000 feet, F-RA	

Occasionally, for traffic reasons, a higher than normal rate of descent (or climb) may be required in order to free the higher flight level left:

Pilot	**ATC**
	F-RA**,** expedite decent to 1000 feet
expediting descent to 1000 feet, F-RA	

As a pilot if you are unable to follow the expedite clearance you shall report that to ATC:

Pilot	**ATC**
unable to expedite, F-RA	

5.3. Maintaining level or stopping level change

Pilot	**ATC**
	F-RA**,** maintain 2000 feet
maintaining 2000ft, F-RA	

Once having been given an instruction to climb or descend, a further overriding instruction may be given to a pilot:

Pilot	**ATC**
	F-RA**,** stop descent at 2000 feet
stopping descent at 2000 feet, F-RA	

6. VFR departure

VFR pilots should report when they are leaving the area of jurisdiction of the ATC unit.

6.1. VFR traffic leave the area

Pilot	ATC
F-RA, passing the control boundary	
	F-RA, Frequency change approved, monitor UNICOM 122.8
(or)	
	F-RA, Contact Faircity Information 125.525
125.525, F-RA,	

6.2. Special VFR traffic leaving procedure

Special VFR will be cleared to leave the control zone in accordance with established procedures.

Pilot	ATC
	F-RA, Leave control zone special VFR via route Whiskey, 3000 feet or below, report W1
Leave control zone special VFR, via route Whiskey, 3000ft or below, will report W1, F-RA	

6.3. VFR exit at a specific point

Pilot	ATC
Reaching SE, F-RA,	
	F-RA, Frequency change approved, monitor UNICOM 122.8
Frequency change approved, monitor UNICOM 122.8, F-RA	

7. Flight in the air in the airfield control zone

VFR flights, when handled by tower or approach control, may be passed information on relevant known traffic in order to assist the pilots in maintaining their own separation.

1.1. Traffic information

Pilot	ATC
Over airfield, F-RA	
	F-RA, traffic Cessna 208 at 1 o'clock 1 miles from left to right 1400feet
Cessna 208 in sight, F-RA	

7.1. VFR Transit

Pilot	ATC
Faircity Tower, F-GLRA, a Cessna C172 from HighVilla to GlobalTown, Delta information, 2000ft, 1 minute over SE, requesting to transit via SE	
	F-RA, transit via SE, SA, over airfield then WA, report over airfield
Will transit via SE, SA, over airfield, WA, and will report over airfield, F-RA	

Transit when VFR pilot is over Airfield:

Pilot	ATC
Over airfield, F-RA	
	F-RA, report over WA
Will report over WA, F-RA	

8. VFR Arrival in terminal area (APP)

Depending on the procedures in use, the pilot of an arriving VFR flight may be required to establish contact with the approach control unit and request instruction before entering its area of jurisdiction.

VFR pilot should acknowledge if ATIS has been received.

Pilot	ATC
Faircity approach, F-GLRA	
	F-GLRA, Faircity approach, hello.
F-GLRA, PA28 VFR from Highvilla to Faircity, 2000ft, over Sierra, information Golf	
	F-RA, cleared to Faircity VFR QNH 1012, traffic southbound Cherokee 2000 feet, 4 miles, 2 o'clock
Cleared to Faircity VFR QNH 1012, traffic in sight, F-RA	
	F-RA, report aerodrome in sight
(after a while)	
F-RA, aerodrome in sight	
	F-RA, contact tower 118.5
118.5, F-RA	

9. VFR Arrival in the controlled zone (TWR)

VFR pilot should acknowledge if ATIS has been received during first contact.

9.1. Join aerodrome circuit from VFR entry point

Pilot	ATC
Faircity Tower, F-GLRA Cessna C172, 10 Miles North, 2500 feet, information Bravo, for landing	
	F-RA, join Right Hand downwind runway 23, wind 330 degrees 10knots, QNH 1012
Will join Right Hand Downwind runway 23 QNH 1012, F-RA	

9.2. Join VFR point from another by request from ATC

Pilot	ATC
Faircity Tower, F-GLRA, A Cessna C172 from HighVilla, over SE, 2000ft with information Delta, for landing	
	F-RA, report over SA
Will report over SA, F-RA	

9.3. VFR straight-in approach

Pilot	ATC
Faircity Tower, F-GLRA, A Cessna C172 from HighVilla, over SE, 2000 ft with information Delta, for landing	
	F-RA, make straight-in approach runway 12, wind 190 degree 5 knots, QNH 1009
Will make straight-in approach runway 12, QNH 1009, F-RA	

9.4. Join final from end of downwind

Pilot	ATC
End of Downwind runway 23, F-RA	
	F-RA, report on final runway 23, number 1
Will report on final runway 23, number 1, F-RA	

9.5. Traffic information when performing pattern

Pilot	ATC
downwind runway 23, F-RA	
	F-RA, number 2, behind Cessna 172 on left hand base leg, report end of downwind runway 23
number 2, Cessna 172 in sight, will report end of downwind runway 23	

9.6. Traffic information with integration number and final report

Pilot	ATC
Downwind runway 35, F-RA	
	F-RA, number 2, follow Cherokee on base
number 2, traffic in sight, F-RA	
	F-RA, report finale runway 35

9.7. Traffic information with incoming traffic on final

Pilot	ATC
downwind runway 23, F-RA	
	F-RA, do you have in sight, B737 4NM final runway 23?
B737 in sight, F-RA	
	F-RA, number 2, behind B737, report on final runway 23
number 2, behind 737, will report end of downwind runway 23	

10. Delaying or expediting instruction

10.1. Extending downwind

Pilot	ATC
Downwind runway 35, F-RA	
	F-RA, extend downwind, number 2, follow Cherokee 4 miles final runway 35.
Will extend downwind, number 2, Cherokee in sight, F-RA	
	F-RA, report finale runway 35

10.2. Holding or delaying instruction

In order to coordinate traffic in the circuit, it may be necessary to issue delaying or expediting instructions, an air traffic controller can issue a holding clearance over a point using visual reference.

Pilot	ATC
	F-RA, orbit right due traffic on the runway.
Orbiting right, F-RA	

A holding procedure for a VFR flight consists of making a 360°.

11. Landing

Controllers should not transmit to an aircraft during take-off, initial climb, the last part of the final approach or the landing roll, unless it is necessary for safety reasons, as it may be distracting to the pilot at a time when the cockpit workload is at its highest.

11.1. Full landing

Pilot	ATC
Final runway 23, F-RA	
	F-RA, Runway 23, cleared to land, wind 270 degrees, 10 knots
Cleared to land Runway 23 F-RA	

11.2. Touch and go

Pilot	ATC
Final runway 23 (for touch and go), F-RA	
	F-RA, runway 23, cleared touch and go, wind 270 degrees, 10 knots
Cleared touch and go runway 23, F-RA	

11.3. Low pass

Pilot	ATC
Final runway 23 (for low pass), F-RA	
	F-RA, Cleared low pass runway 23, wind 270 degrees, 10 knots
Cleared low pass runway 23, F-R	

11.4. Stop and Go

Pilot	ATC
Final runway 23 (for stop and go), F-RA	
	F-RA, Cleared to land runway 23, wind 270 degrees, 10 knots
Cleared to land runway 23, F-R	

After the traffic is immobilized on the runway:

Pilot	ATC
	Report ready for take-Off
Will report when ready for take-Off	

12. Go around procedure

A go around procedure shall be initiated by the pilot or the ATC.

Instructions to carry out a missed approach may be given to avert an unsafe situation. When a missed approach is initiated, the cockpit workload is inevitably high.
Any transmissions to aircraft going around should be brief and kept to a minimum.

12.1. ATC requests a go around

An ATC shall issue a go-around if:

- the landing runway is not free
- the separation will be below the limits (collision avoidance) defined by the regulations
- the separation cannot ensure a landing for the following aircraft

Pilot	ATC
	F-RA, go around, aircraft on the runway.
going around, F-RA	

An aircraft must initiate a go around procedure when instructed by the ATC and aircraft is not authorized to land.

12.2. Pilot performs a go around

A pilot shall perform a go-around if:

- He can see an obstacle on the landing runway (vehicle, aircraft, material, people…)
- He does not see the runway
- He cannot land considering the current flight conditions (wind shear, cross wind, missing approach, wake turbulence, too high speed, too high altitude…)
- He does not receive any landing clearance starting from the short final (2NM) to the runway threshold at the latest.

Pilot	ATC
going around, F-RA	
	F-RA, Roger.

Unless instructions are issued to the contrary, an aircraft on an instrument approach (IFR) will carry out the missed approach procedure and an aircraft operating VFR will continue in the normal traffic circuit.

A go-around clearance cannot be cancelled by the ATC when a pilot has already started a go-around.

13. Hand-Off with Ground Controller

Unless otherwise advised by ATC, pilots should remain on the tower frequency until the runway is vacated. Just make this hand off procedure only if a separate ground controller is active.

Pilot	ATC
Runway 23 vacated, F-RA	
	Contact Faircity Ground, 121.9
Contacting Faircity Ground, 121.9	

14. Taxi to general aviation apron and leave the frequency

After vacating, the pilot in command shall ask a taxi clearance to continue:

Pilot	ATC
Faircity Ground, runway 23 vacated on Delta, F-RA	
	F-RA, taxi general aviation apron
Taxiing general aviation apron, F-RA	

Usually, the VFR pilot monitors the ATC frequency during taxi and quit.

If the pilot wants to give an acknowledgement to ATC, just do it like this:

Faircity tower, leaving frequency, F-RA	
	F-RA, good day.

Engine shutdown is the pilot's responsibility and pilot does not need any acknowledgement from ATC to do that.



VFR INITIAL CLEARANCE ON GROUND

1. Introduction

This article is applicable only for VFR pilots on a controlled airfield and for air traffic controllers handling VFR departures from a controlled airfield.

The first task for a pilot is to fly safely. Before flying, he needs charts and shall prepare his flight.

The first task for an air/ground traffic controller is to have VFR charts when controlling and read them all in order to catch all local restrictions and recommendations.

2. Initial VFR clearance for departure

2.1. Generalities

Inside controlled zones or airfields, VFR pilots have to receive an initial clearance.
Usually, the VFR pilot will start his aircraft prior to contacting the controller. And he is ready to taxi.

Be aware that some specific airfields do not allow this; please consult your charts.
Specific rules have to be taken from the local procedures.

The controller gives the initial VFR clearance to the pilot. This clearance can include:

- The taxi clearance to adequate holding point of an active runway.
- Waiting clearance on apron if the traffic is not ready for an immediate VFR departure
- Transponder/squawk code
- The exit point defined by the tower controller when needed or required by regulation
- Altitude and speed restrictions defined by the tower controller when needed
- Ground traffic information when needed
- Local weather and/or QNH if there is no ATIS or no METAR information available.

As a minimum, an initial clearance shall include taxi clearance with a transponder code or wait clearance on apron.

Of course, there is no specific rule to follow whether to give particular information or not . It is the controller's ability and efficiency that drives the clearance flow.

2.2. Night VFR – NVFR

The night VFR flight – called NVFR sometimes – is a VFR flight which is partly performed during the aeronautic night.

A NVFR clearance has to contain the route, how to leave the airport.

This is either done using:

- a specific direction or landmark point
- reporting points
- VFR departure routes

In some countries or airfields, night VFR clearances are not allowed.
Please consult your national and local regulation.

2.3. Special VFR – SVFR

In a controlled aerodrome, the air traffic controller can **issue a special VFR clearance to an aircraft**, which is below the VMC minima in his controlled zone, in order **to let him reach a new zone where the weather conditions follow the VMC rules**.

Flight visibilities reduced to not less than 1500m (clear of clouds) is permitted for special VFR flights at speeds that give adequate opportunity to observe other traffic or any obstacles in time to avoid collision.

Special VFR clearance use depends on your local regulation (ATS authority).
This type of clearance can be forbidden in some countries or on some airfields.

2.4. Advices for the pilot

As a pilot performing a VFR flight and departing from a controlled airfield, you must contact the ATC before taxi in order to have the initial VFR clearance.

You will obtain this clearance from a ground or tower controller.
In other airports, you may ask the approach controller to obtain your clearance.

In IVAO, it is **mandatory that every user connected as a pilot fills a flight plan even for a VFR flight**.
The route is not mandatory for VFR, but it can be useful for air traffic controllers.

There is no pushback clearance for light aircraft. In real life, you use human power to push the aircraft to a free position on the apron. For bigger aircraft, you can position it on the apron in a place allowing enough space for taxi without the need of pushback.

The following tasks shall have been done before initial contact:

- VFR Flight prepared (route, fuel, flight time, …)
- Charts on board
- ATIS checked
- Weather check versus VMC conditions
- Aircraft checked on ground without moving

After your first contact with ATC, you will have the following possibilities:

- Taxi clearance to holding point, with or without exit point and altitude restrictions, airfield information, traffic information, transponder/squawk code.
- No clearance due to an extra departure delay

2.5. Advices for the controller

When managing VFR flights on ground, you need to know that VFR pilots want a quick departure and they are ready to go when calling the controller for the first time. VFR pilots usually already started their engines when contacting the controller.

There is no pushback need for a VFR flight (except for largest aircraft).

The mobility of a light aircraft is enough to avoid the pushback clearance. Then, you can give the taxi clearance during the first contact.

Before giving the taxi clearance, you must verify that:

- The pilot has filled a correct and adequate flight plan (in IVAO a pilot is not allowed to fly without filling a minimum information in his flight plan)
- The departure sequence can allow a VFR departure within maximum 15/20 min.
- Too much delay before departure will make VFR unhappy. In real life, VFR pilots pay for their own fuel!

With an airspace class F or a non-controlled airfield (auto information airfield written on charts), as the active controller, you have to give traffic information only without any taxi instructions or even take-off or landing clearances.

The controller can manage VFR traffic selecting different taxiways, holding points or runways for VFR or light aircraft for any of the following reasons:

- Some taxiways can have resistance restrictions that allows the taxi of light aircraft only
- Light aircraft can have a specific holding point before departure in function of local restrictions
- VFR or light aircraft have a specific dedicated runway in function of local restrictions or departure

A special VFR flight shall not be considered as a normal VFR flight. Please consult your national regulations in order to know which are the separation and requirements for this type of flight.

2.6. Example with a VFR exit point

Pilot	ATC
F-GLRA, Cessna C172, at the general aviation apron, with information **Delta**, request taxi for VFR flight destination HighVilla	
	F-RA, exit via SE, squawk 7006, taxi holding point runway 23 via taxiway Alpha
exiting via SE, squawk 7006, taxiing holding point runway 23 via taxiway Alpha, F-RA	

3. Additional advices when training in an aerodrome circuit

3.1. Advices for the pilot

When requesting to perform an aerodrome circuit pattern, the pilot must have in mind all aerodrome circuit parameters (altitude, hand, restriction…).

These parameters can be:

- Found on charts
- Known by pilot and air traffic controller as real local parameters
- Defined by the tower controller (in function of traffic)

A pilot shall perform the aerodrome circuit using the parameters published on the charts except when the air traffic controller gives the pilot specific parameters. The pilot shall perform the aerodrome circuit accordingly.

In IVAO, it is mandatory that every user connected as a pilot fills a flight plan even for an aerodrome circuit flight.
In that case, the route must be left blank because a traffic pattern is not a route, it shall not be inserted in the route field of the flight plan.

If you do not have the charts and do not know the pattern parameters, as a pilot, just obtain the parameters from the controller.

3.2. Advices for the controller

The tower controller (or the controller who manages this position) is the responsible of the aerodrome circuit. In function of traffic (speed, type of aircraft …), the controller can set different parameters for one or several aircraft performing an aerodrome circuit. That is the controller's responsibility.

When giving an initial VFR clearance for an aerodrome circuit, you can give the circuit parameters inside the initial clearance as a reminder for the pilot. It is sometimes useful especially for new IVAO pilots as there are few of them that have the required charts.

When giving an aerodrome circuit clearance, as a controller, you must be sure that the aircraft will not wait more than 5 minutes at the holding point.

3.3. Examples

Example without circuit description:

Pilot	ATC
F-RA, Cessna C172, at the general aviation apron, with information Delta, request taxi for circuit patterns	
	F-RA, squawk 7006, taxi holding point runway 23

If there is no circuit description, the pilot shall follow the circuit published on charts.

Example with circuit description:

Pilot	ATC
F-RA, Cessna C172, at the general aviation apron, with information Delta, request taxi for circuit patterns	
	F-RA, right hand circuit, 1400feet, squawk 7006, taxi holding point runway 23



VFR FLIGHT PLANNING

1. Introduction

Planning a cross-country flight cannot seem like an easy task. Flight planning can be a lot of work but the more you do it, the easier it gets! Here's a step-by-step process.

2. Choose your flight

The first task is to choose a departure airfield and a destination airfield.

In real flight, the departure is where the airplane is parked.
In IVAO, you have the opportunity to choose your departure airfield around the world.

You may need to fly to more than one airport or at least 150 nautical miles. During an IVAO exam or during personal training, you can fly in different types of airspace environments, and go to uncontrolled airfields or a busier towered airport.

Another thing to keep in mind is the route of flight based on the weather conditions and NOTAMs. Once you have a destination in mind, briefly check the weather and NOTAMs before you continue to ensure you will not run into bad weather or a closed runway.

For exam preparation, make sure the training objectives are being met, and you have no weak areas in your training.

3. Choose your route

You should choose a route that will allow you to fly at an optimum altitude and cruise setting for your aircraft while still allowing you to easily identify checkpoints on the ground.

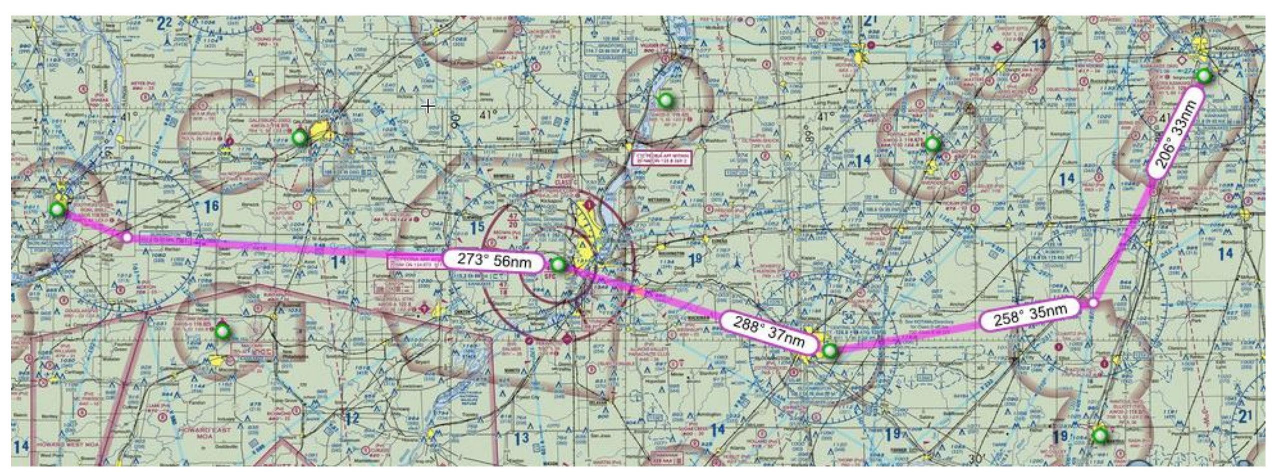
If you fly a small airplane, you might not be able to climb high enough to fly over a mountain range and your only option might be to go around it. Be aware of terrain, restricted and military areas and temporary flight restrictions when you plan your route. And also, take into account the VFR routes that go in and out of busy airports.

There are several methods to choose a route:

- Dead reckoning
- Radio navigation aids
- GPS
- Combination of all methods.

Once you choose your route, plot it out on a sectional map.

The pilot typically uses a flight planning log to keep track of the calculations during flight.
You can use the website http://skyvector.com/



Example KIKK – KBRL route: KIKK RBS KBMI KPIA BRL KBRL

3.1. Dead reckoning

At the most simple level, VFR navigation is accomplished through ideas known as dead reckoning and pilotage. Pilotage is a term that refers to the sole use of visual ground references. The pilot identifies landmarks, such as rivers, towns, airports, and buildings and navigates among them.

Choose checkpoints that are 5-10 nautical miles apart and are easy to identify. Lakes, rivers, towns, highways and other airports are usually easy to spot. Over very flat land with less-than-ideal checkpoints, you might get lost.
The trouble with pilotage is that often, references are not easily seen and cannot be easily identified in low visibility conditions or if the pilot gets off track even slightly. Therefore, the idea of dead reckoning was introduced.

Dead reckoning involves the use of visual checkpoints along with time and distance calculations. The pilot chooses checkpoints that are easily seen from the air and also identified on the map, and then calculates the time it will take to fly from one point to the next based on distance, airspeed, and wind calculations

It is important to stay aware of your position at all times, so do not be afraid to plan a deviation from the straight-line path in order to find your way.

3.2. Radio navigation

During visual meteorological conditions (VMC), a pilot might fly by using pilotage and dead reckoning alone, or he might use radio navigation aids or GPS navigation techniques.

With aircraft equipped with radio navigation aids, pilots can navigate more accurately than with dead reckoning alone. Radio NAVAIDS are useful in low visibility conditions and can be used as a back-up method for general aviation pilots. They are also more precise.

NAVAIDS are also required for IFR operations.

There are different types of radio NAVAIDS used in aviation:

- ADF/NDB: The most elementary form of radio navigation is the ADF/NDB pair. The ADF instrument is basically an arrow pointer placed over a compass card-type display.
- VOR: The VOR system is probably the most commonly used NAVAID in the world. VOR is a radio-based NAVAID that operates in the very-high-frequency range. VOR stations are located on the ground and transmit two signals -- one continuous 360-degree reference signal and another sweeping directional signal.
- DME: DME transmits on UHF frequencies, and computes slant-range distance. It is a basic method using a transponder in the aircraft to determine the time it takes for a signal to travel to and from a DME station.

3.3. Modern navigation using GPS

The global positioning system has become the most valuable method of navigation in the modern aviation world. GPS has proven to be tremendously reliable and precise, and is probably the most common NAVAID in use today.

The global positioning system uses 24 U.S. Department of Defense satellites to provide precise location data, such as aircraft position, track, speed, and distance to pilots.

GPS has become a preferred method of navigating due to the accuracy and ease of use.

4. Get a Weather Briefing

In the IVAO network, the weather can be obtained in several ways:

- Get METAR and/or TAF from the network using IvAp
- Get METAR and/or TAF from real aviation system (be aware that some differences can exist between IVAO and reality, even if IVAO takes the weather information from reality)
- Get weather information when reading ATIS of the air traffic controllers connected.

You must check the current weather information and forecast of your arrival airfield. But, do not forget to check the departure or intermediate airfield weather and forecast.

5. Choose an altitude and cruise profile

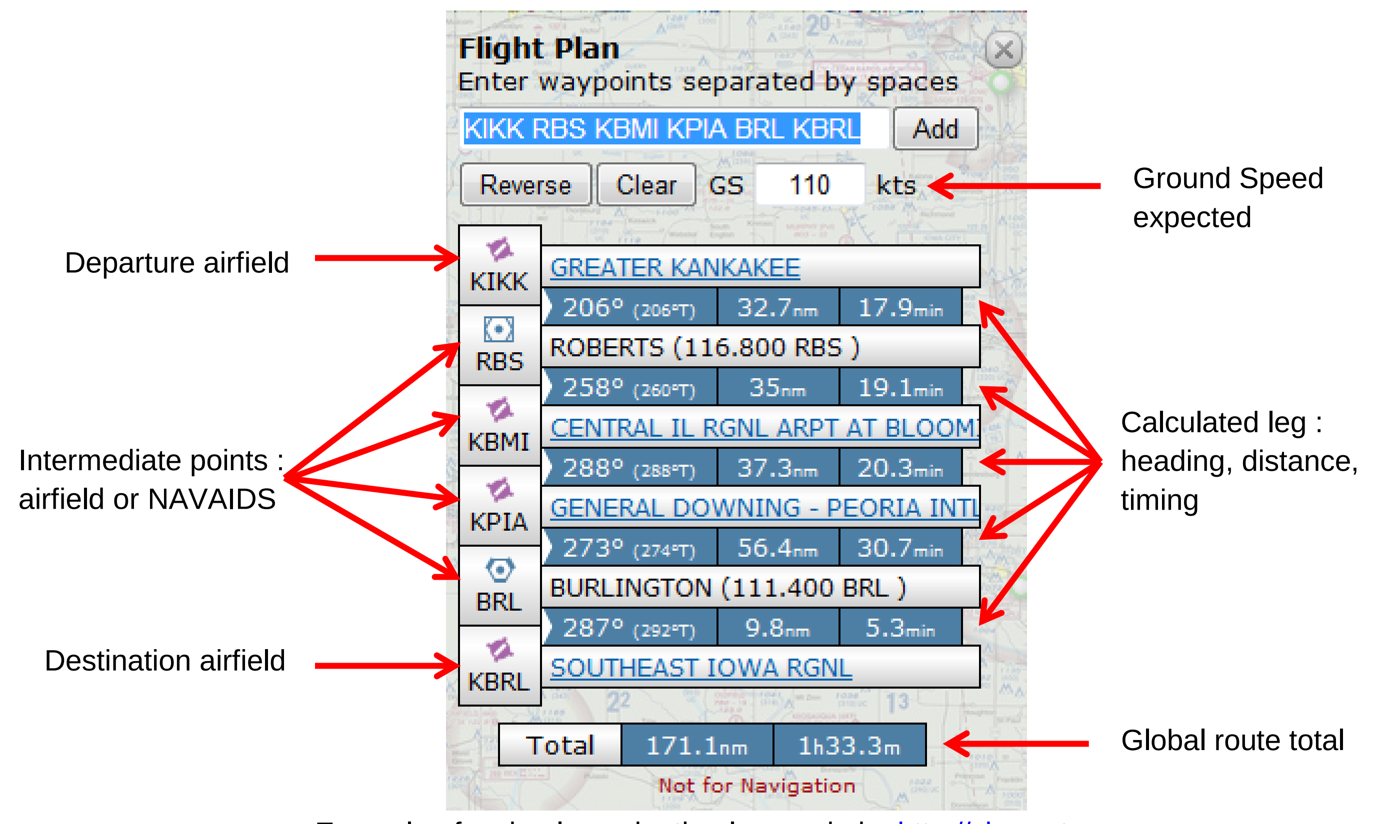
As a VFR pilot, you should fly high enough to maintain the required clearance from terrain and obstacles, and should consider aircraft performance and the ability to find checkpoints from the air, as well.

The performance charts in the pilot operating handbook or pilot information manual for your aircraft can help you to determine an altitude and cruise power setting to use to get the best range or best endurance.

6. Compute heading, time and distance

You will need to complete the speed, heading, distance and time for each leg of the flight, as well as fuel consumption. It is easiest to follow a navigation log form for this. You can do it by hand (with the help of a flight computer) or use a trusted computer.

Using a navigation log can help you organize the calculations in a way that makes sense and is easy to use.



Example of a simple navigation log made by http://skyvector.com

7. Familiarize yourself with the airports

If you have ever been stuck at a busy airport without an airport diagram, then you know that it is imperative to keep your situational awareness even after you land. If you are unfamiliar with them, large airports can be challenging and you can get lost yourself. Taxi instructions can be lengthy and your aircraft can be surrounded by medium or heavy aircraft.

A preliminary study of the ground layout especially for the biggest airfields is highly recommended.
A check of airspace around the selected airfield you will cross is also recommended. Some airfields have several layers of airspace and it is sometimes hard to find when flying when you enter in controlled airspace.

In real aviation, you should want to know the hours of operation, fuel service availability and other services at your disposal.

8. Check your equipment

If you are reliant on certain navigational instruments, make sure they work.
Ensure the GPS database is up to date and working for your flight, and make sure the navigation instrument check has been done to ensure the VOR/NDB system is reliable.
Also check that the charts are available and you do not miss one!

9. File a flight plan

While you are getting your weather briefing and your route has been chosen, it is time to file a flight plan.
In IVAO for a VFR flight, you can fill a short flight plan with no route. But declaring your route in your flight plan will help air traffic controllers to manage your flight.

For IVAO flight examination, the route is mandatory.

10. Be Prepared for the Unexpected

Sometimes things do not go as planned. Be prepared mentally to adjust your plans as necessary:

- If the winds are stronger than predicted, you might need to adjust your calculations en route and even update the flight plan and give a new ETA (estimated time arrival)
- If your VOR/NDB fails, you might need to rely more heavily on your map reading skills
- If the weather deteriorates, you may need to divert to a different airport or adjust your route

If you plan for the unexpected, you will be ready for anything

VFR NAVIGATION LOG

Aircraft Number	N	Notes

Check Points (Fixes)	VOR	Course (Route)	Altitude	Wind		CAS	TC	TH	MH	CH	Dist.	GS	Time Off		GPH
	Ident			Dir.	Vel.						Leg	Est.			
	Freq.			Temp		TAS	-L / +R WCA	-E / +W Var.	± Dev.		Rem.		ETE	ETA	Fuel
												Act.	ATE	ATA	Rem.
		Totals »													

Flight Plan and Weather Log on Reverse Side

Airport & ATIS Advisories

Departure		Destination
	ATIS Code	
	Ceiling & Visibility	
	Wind	
	Altimeter	
	Approach	
	Runway	
	Time Check	

Airport Frequencies

Departure		Destination	
ATIS		ATIS	
Ground		Approach	
Tower		Tower	
Departure		Ground	
CTAF		CTAF	
FSS		FSS	
UNICOM		UNICOM	
Field Elev		Field Elev	
Block In		Log Time	
Block Out			

MU436183H

WEATHER LOG

	Ceiling, Visibility and Precipitation		Winds Aloft	Icing and Freezing Level	Turbulence and Cloud Tops	Position of Fronts, Lows and Highs
	Reported	Forecast				
Departure						
Enroute						
Destination						
Alternate						

FLIGHT PLAN

1. Type	2. Aircraft Identification	3. Aircraft Type/ Special Equipment	4. True Airspeed	5. Departure Point	6. Departure Time		7.Cruising Altitude
VFR					Proposed (Z)	Actual (Z)	
IFR							
DVFR			Knots				

8. Route of Flight

9. Destination (Name of airport and city)	10. Est. Time Enroute		11. Remarks
	Hours	Minutes	

12. Fuel on board		13. Alternate Airport(s)	14. Pilot's Name, Address, Tel # & Aircraft Home Base	15. # Aboard
Hours	Minutes			

16. Color of Aircraft	17. Destination Contact / Telephone (Optional)

CLOSE VFR FLIGHT PLAN WITH ____________________ FSS ON ARRIVAL

Special Equipment Suffix

/X-No Transponder
/T-Transponder with no altitude encoding capability
/U-Transponder with altitude encoding capability
/D-DME, no transponder
/B-DME, transponder with no altitude encoding capability
/A-DME, transponder with altitude encoding capability
/R-RNAV, transponder with altitude encoding capability
/C-RNAV, transponder with no altitude encoding capability
/W-RNAV, no transponder
/G-Global Positioning System (GPS)/Global Navigation Satellite System (GNSS) equipped aircraft with ocianic, enrout, terminal, and GPS approach capability.

Notes and NOTAMs

Position Report

Acft. Ident.	Position	Time	Alt.	IFR/ VFR	Est. Next Fix	Name Following Fix

Report Conditions Aloft - Cloud Tops, Bases, Layers, Visibility, Turbulence, Haze, Ice, Thunderstorms



INTRODUCTION TO NAVIGATION

1. DIRECTIONS

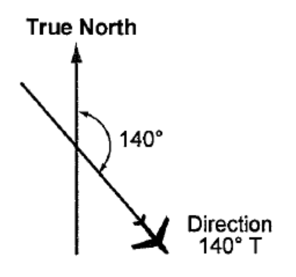
Direction can be measured in various ways. All directions are measured clockwise in degrees from 0º to 359º.
In all cases the direction "To" or "From" a position will be measured with reference to a particular datum, usually North.

There are four main types of direction, referred to Air Navigation:

- Degrees True (ºT): Relative to True Heading (TH).
- Degrees Magnetic (ºM): Relative to Magnetic Heading (MH).
- Degrees Compass (ºC): Relative to Compass Heading (CH).
- Degrees Relative (ºR or ºRel): Relative to a known position.

1.1. True direction

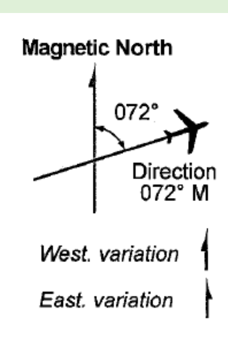
True direction is measured with respect to True North (TN), which is the direction of the Geographic North Pole from a place.



The direction of the True North is indicated by the meridian at the actual place where the measurement is made, since meridians always run in a North/South direction.
Navigation charts and maps are usually based on True Directions.

1.2. Magnetic direction

The Earth may be considered as a magnet producing an irregular magnetic field with North and South Poles. Those Poles are near to the geographic poles but may not be directly opposite each other. The Magnetic Poles move constantly, completing a full rotation of 360º each 960 years.



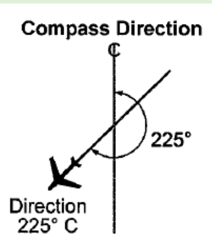
When a magnetized compass needle is freely suspended in the magnetic field of the Earth, it will align itself along the magnetic field, indicating the direction of the Magnetic Poles at that place. The magnetic imaginary lines that connect North and South Magnetic Poles are known as magnetic meridians.

The Magnetic Direction is measured with respect to Magnetic North (MN), which is the direction of the Magnetic North Pole from a place. Error-free compasses (also known as Direct Indicating Compasses) show Magnetic Heading (MH).

1.3. Compass direction

Any magnetic or ferrous material or electrical equipment on or near the aircraft compass will affect the local magnetic field and may deflect the compass needle away from the Magnetic North (MN). This means that the Compass may not show Magnetic Heading accurately.

When a compass is affected by a local magnetic field, it points to that Compass North. Normally, there is a deviation chart near to each Compass where deviation can be seen.



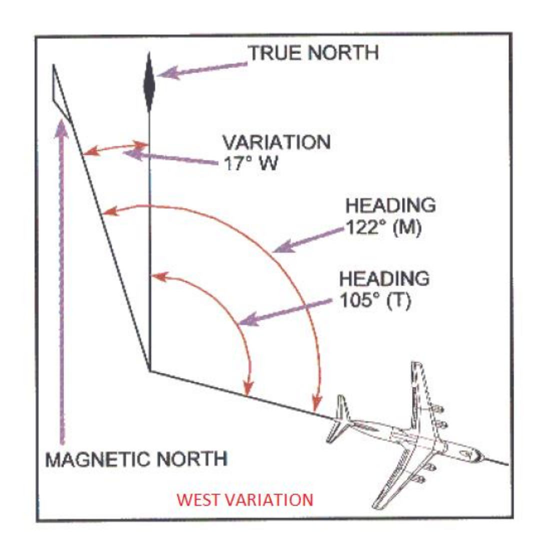
Note that this deviation may not be simulated on our simulators.

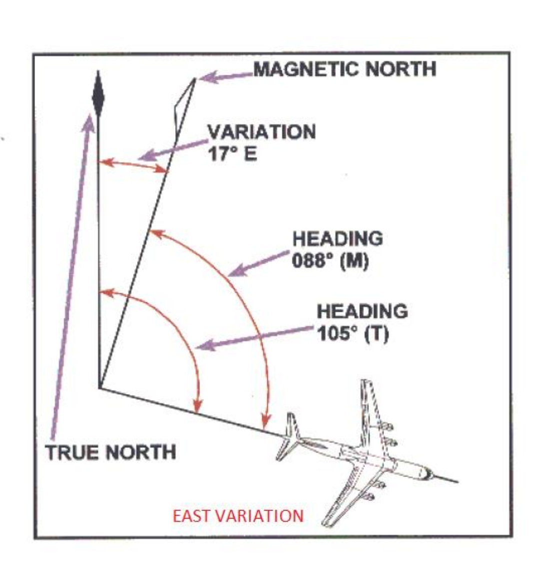
1.4. Variation and deviation

The angle between the True North (TN) and the Magnetic North (MN) is called 'variation'.

It is measured from the TN to the MN. If the Magnetic North is west of the True North, variation is west, and vice versa.

Example:
If MN is 4º west of TN, variation is 4º W or -4º
If MN is 8º east of TN, variation is 8º E or +8º

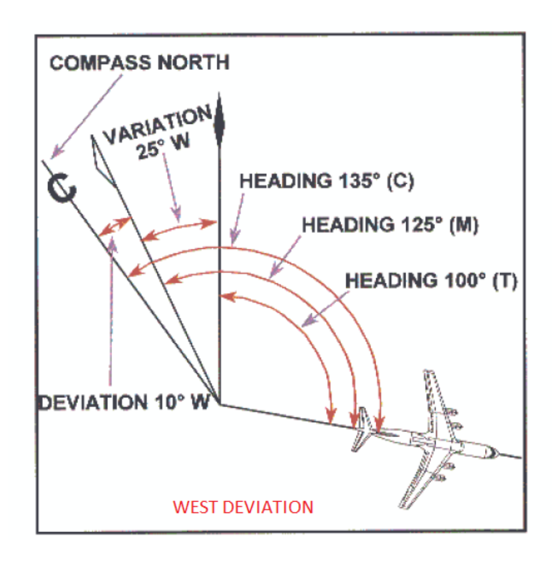


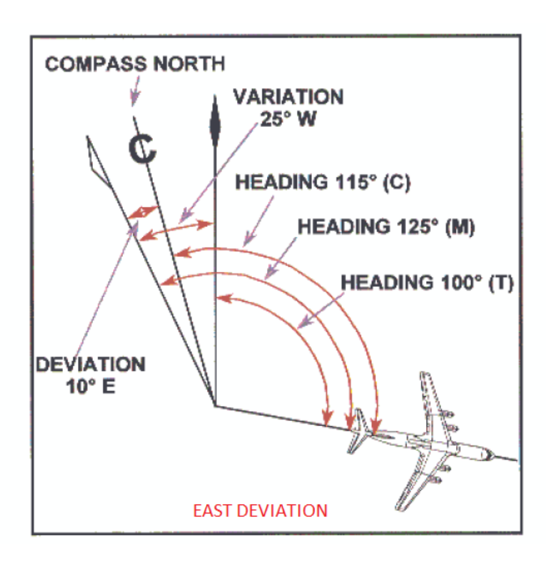


The angle between the Magnetic North (MN) and the Compass North (CN) is called 'deviation'.

It is measured from the MN to the CN. If the Compass North is west of the Magnetic North, deviation is west, and vice versa.

Example:
If CN is 3º west of MN, deviation is 3º W or -3º
If CN is 5º east of MN, deviation is 5º E or +5º.



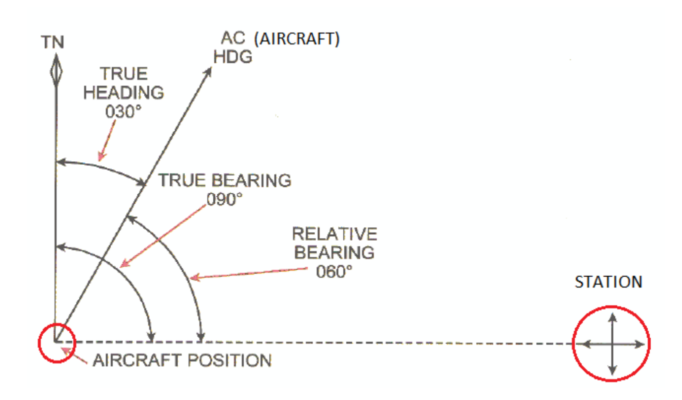


1.5. Relative Direction

A Relative Bearing (RB) is a bearing measured with respect to the nose of the aircraft or to the aircraft Magnetic Heading (MH).

They are used mostly on ADF equipment to obtain the station's relative position.

Bearings can be FROM the aircraft TO the station or FROM the station TO the aircraft. They are always measured clockwise.



In order to calculate Magnetic Bearing (MB), this formula can be used, from the aircraft to the station:

RB + MH = MB
Relative Bearing + Magnetic(true) Heading = Magnetic(true) Bearing

1.6. Reciprocal bearing

The reciprocal of a direction is the reverse direction, which has a difference of 180º. It can be obtained by adding or deducting 180º to the MB to the station, whichever results in a number smaller than 360º.

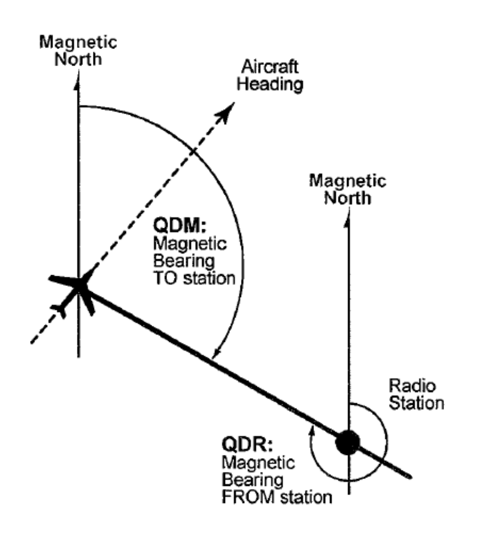
Example:
If the Magnetic Bearing from the aircraft to the station is 250º, the reciprocal is 250º - 180º = 070º.

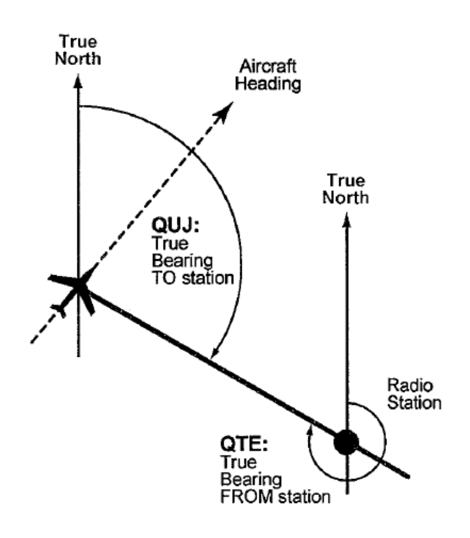
Note that if we add 250º + 180º = 430º, we do not obtain a valid bearing as it is greater than 360º.

2. Q-codes used in Navigation

In navigation documents, there are some Q-codes that abbreviate the mostly used bearings:

- **QDM**: Magnetic Bearing TO the station (from the aircraft)
- **QDR**: Magnetic Bearing FROM the station (to the aircraft)
- **QUJ**: True Bearing TO the station (from the aircraft)
- **QTE**: True Bearing FROM the station (to the aircraft)







VISUAL FLIGHT RULES

1. Introduction

Visual flight rules (VFR) are a set of regulations under which a pilot operates an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going.

Using the VFR Flight rules, the pilot must be able to operate the aircraft with visual reference to the ground, and by visually avoiding obstructions and other aircraft.

2. VFR weather minima or Visual Meteorological Conditions (VMC)

Except when operating as a special VFR flight, all VFR flights shall be conducted in VMC, conditions of visibility and distance from clouds equal to or greater than the minima presented in the **table below**:

Altitude band	Airspace class	Minimum flight visibility	Minimum distance from clouds
At and above 3050m (10000ft) AMSL	A, B, C, D, E, F, G	8 km	1500 m horizontally 300m (1000ft) vertically
Below 3050m (10000ft) AMSL And above, 900m (3000ft) AMSL or 300m (1000ft) above terrain, whichever is the higher	A, B, C, D, E, F, G	5 km	1500 m horizontally 300m (1000ft) vertically
At or below 900m (3000ft) AMSL or 300m (1000ft) above terrain, whichever is the higher	A, B, C, D, E	5 km	1500 m horizontally 300m (1000ft) vertically
	F, G	5 km (*)	Clear of cloud and with the surface in sight
Visual Meteorological Condition (VMC)			

Remark (*):

- Flight visibilities reduced to not less than 1500m may be permitted in some countries for flights at speeds that give adequate opportunity to observe other traffic or any obstacles in time to avoid collision.

Other Remarks:

- When the height of the transition altitude is lower than 3050m (10000ft) AMSL, FL100 should be used.
- Helicopters **may be permitted to operate in less than 1500m flight visibility** if they can observe other traffic and any obstacles in time to avoid collision. (Depends on your country regulations).
- The VMC minima in class **A** airspace are included for guidance to pilots and **do not imply acceptance of VFR flights in class A** airspace automatically.

3. VFR Level restrictions

3.1. Minimal altitude

All VFR flights shall not be flown except for take-off, landing or except by emission from the appropriate authority:

- At a height less than 150 m (500 ft) above the ground or water.
- At a height less than 300 m (1 000 ft) above the highest obstacle within a radius of 600 m from the aircraft over the congested areas of cities, towns or settlements or over an open-air assembly of persons.

Some countries adopt a minimum height above 1000ft over natural parks and reserves.
Some countries also make a minimum height of flight between 1000ft to 5000ft over cities.

3.2. Maximal altitude or flight level

VFR civil flights shall not fly above FL200.
All VFR flights are forbidden in RVSM airspace above FL290.

The maximum VFR flight level is ICAO defined. According to your national regulation (AIP), it may be different.

For military aircraft, please consult **Special Operations Department** for HQ rules or your Special Operations rules of your division to have the exact limitations.

3.3. Cruising flight level

Except where otherwise indicated in air traffic control clearances or specified by the appropriate ATS authority, VFR flights when operated above 900 m (3 000ft) from the ground or water shall be conducted at a flight level/altitudes appropriate to the track as specified in the following levels :

- **VFR flights use flight levels ending with the number 5**: FL 45, FL 55, …
- **VFR flights use altitudes ending with the number 500**: 4500ft, 5500ft, …

The cruise altitude (flight level) for VFR flights must be chosen using this assigned rules and must follow the semicircular rules depending on the heading of the aircraft.
Check VFR cruise altitude documentation in order to have the full table with explanations including semi-circular rules.

4. Air traffic Controlled Areas

An air traffic control clearance shall be obtained prior to operating a controlled flight or a portion of a flight as a controlled flight:

- When operating a class B, C and D airspace
- When forming part of aerodrome traffic at a controlled aerodrome
- When operated special VFR

In those cases, an aircraft operated as a controlled flight shall maintain continuous voice communication and establish two-way communication with the appropriate air traffic control unit.

Note that in IVAO, the pilot must use text mode if the voice communication is not possible.

5. Change Flight Rules to IFR

An aircraft operated in accordance with the visual flight rules which wishes to change to compliance with the Instrument Flight Rules shall:

- communicate the necessary changes to be effected to its current flight plan
- submit a flight plan to the air traffic services unit and obtain a clearance prior to proceeding IFR when in controlled airspace

6. Special VFR (SFVR)

In a controlled aerodrome, the air traffic controller can issue a special VFR clearance to an aircraft, which is below the VMC minima in his controlled zone, in order to let him reach a new zone where the weather conditions follow the VMC rules.

Special VFR clearance use depends on your local regulation (ATS authority):
This type of clearance can be forbidden in some countries or on some airfields.
Flight visibilities reduced to not less than 1500m (clear of clouds) is permitted for special VFR flights at speeds that give adequate opportunity to observe other traffic or any obstacles in time to avoid collision.

7. Night VFR (NVFR)

The night VFR flight – called NVFR sometimes – is a VFR flight which is partly performed during the aeronautic night.

In some countries or airfields, night VFR flights are not allowed.
Please consult your national and local regulations.



VFR CRUISE ALTITUDE OR FLIGHT LEVEL

1. Introduction

When you are a VFR pilot, you must take into account when to choose for a cruise altitude or flight level; there are some minimum rules to respect. This article will help you choose one of the possible solutions.

2. VFR altitude and level restrictions

2.1. Minimal altitude

Except for take-off, landing or by emission from the appropriate authority, VFR flights shall be flown:

- At a height not less than 300m (1 000ft) above the highest obstacle within a radius of 600 m from the aircraft over the congested areas of cities, towns or settlements or over an open-air assembly of persons.
- At a height not less than 150m (500ft) above the ground or water except over the congested areas of cities, towns or settlements.

Some countries adopt a minimum height above 1000ft over natural parks and reserves.
Some countries also require a minimum height of flight between 1000ft to 5000ft over cities.

2.2. Maximum altitude or flight level

VFR civil flights shall not fly above FL200.

For military aircraft, please consult **Special Operation Department** for HQ rules or the Special Operation rules of your division to have the exact limitations.

3. Cruise altitude or flight level selection

3.1. Free altitude?

VFR flights in level cruising flight when operated below 900 m (3 000 ft) from the ground or water are free.

Above this previous altitude, the cruise altitude or flight level is not free. You must choose it according to the semi-circular rules (see next chapter).

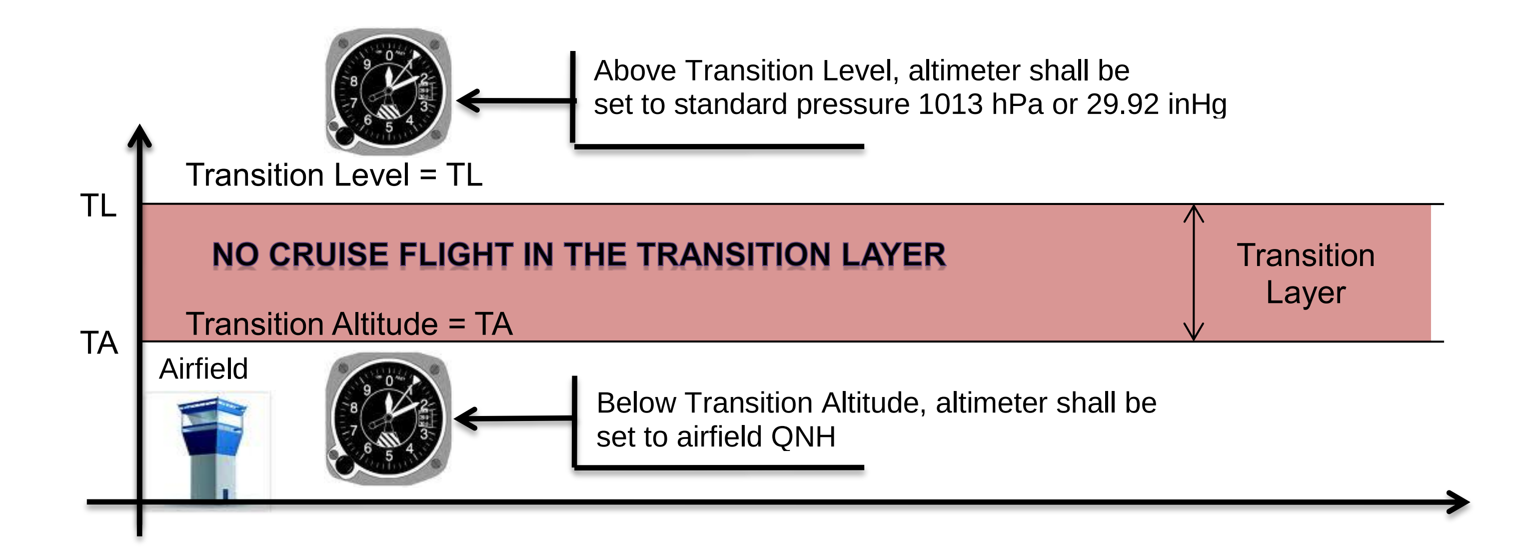
A higher level can be specified by the appropriate ATS authority.

3.2. Transition layer constraints

The transition layer is the airspace between the transition altitude and the transition level.

Consult our altimetry documentation for pilot or controller in order to have more information about transition layer, transition altitude and transition level.

No cruise flight level or cruise altitude can be chosen in the transition layer.



3.3. Available VFR levels

Except where otherwise indicated in air traffic control clearances or specified by the appropriate ATS authority, VFR flights when operated above 900 m (3 000 ft) from the ground or water shall be conducted at a flight level/altitudes appropriate to the track as specified in the following levels :

- **VFR flights use flight levels ending with the number 5**: FL 45, FL 55, FL 135, FL 195…
- **VFR flights use altitudes ending with the number 500**: 4500ft, 5500ft, 13500ft, 19500ft…

The cruise altitude or cruise flight level must be chosen using this assigned rule and must follow the semi-circular rule depending on the heading of the aircraft (see next chapter).

Note that IFR flight levels end with final number 0 and not 5. This provides enough separation between VFR and IFR flights and adequately avoids possible conflicts during the cruise phase.

3.4. Odd and even flight levels

For answering to the need of flight level separation between the same types of flight, flight levels have been separated in two categories, the even and the odd flight level:

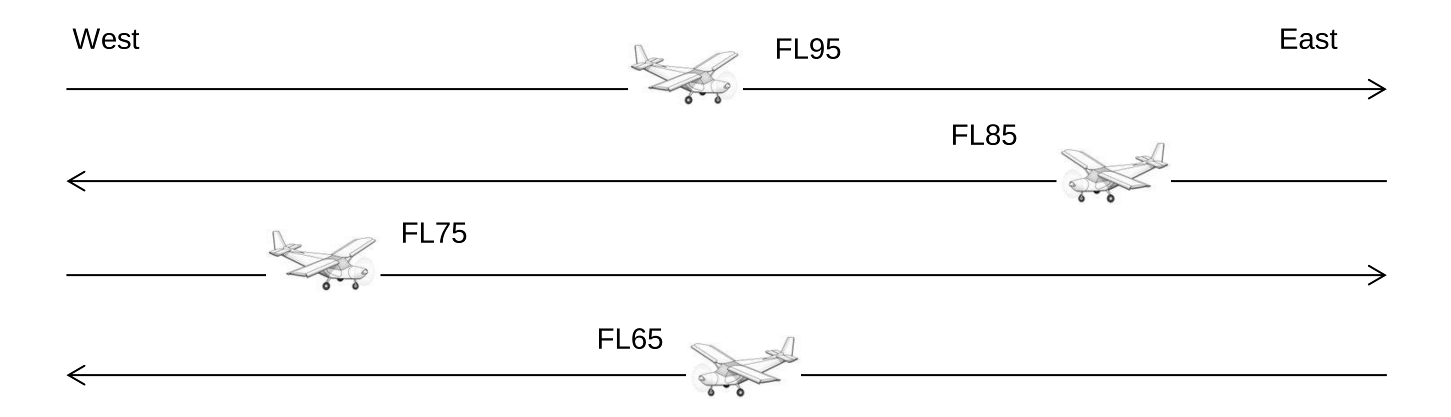
- **Even** flight level: the last number before the final number 5 shall be even: FL 45, FL 65, FL 125…
- **Odd** flight level: the last number before the final number 5 shall be even: FL 55, FL 75, FL 135…

4. Semicircular rule

4.1. Default worldwide semicircular rule

The default worldwide semi-circular rule is the East/West orientation of the flight level parity:

- Your aircraft has track between **0°** and **179°**, your flight level or altitude must be **odd.**
- Your aircraft has track between **180°** and **359°**, your flight level or altitude must be **even**



By following the semi-circular rule, a VFR aircraft will limit possible conflicts with another aircraft coming from the opposite direction through providing 1000ft separation between opposite west/east tracks.

4.2. Specific semicircular rule

In some counties due to IFR routes or special regulations set by the local administration, the **semi-circular rule can be the North/South** orientation of the flight level parity:

- Your aircraft has track between 90° and 269°, your flight level or altitude must be **odd**
- Your aircraft has track between 270° and 359° & between 0° and 89°, your flight level or altitude must be **even.**

5. List of available flight level and altitude

Be aware that no civil VFR flight is allowed above FL195.

Some countries (like Russia) adopt a metric airspace above the transition level.

5.1. In a normal airspace

VFR Flight					
Track from 0° to 179°			Track from 180° to 359°		
FL	Feet	Meter	FL	Feet	Meter
35	3500	1050	45	4500	1350
55	5500	1700	65	6500	2000
75	7500	2300	85	8500	2600
95	9500	2900	105	10500	3200
115	11500	3500	125	12500	3800
135	13500	4100	145	14500	4400
155	15500	4700	165	16500	5050
175	17500	5350	185	18500	5650
195	19500	5950	205	20500	6250
215	21500	6550	225	22500	6850
235	23500	7150	245	24500	7450
255	25500	7750	265	26500	8100
275	27500	8400	285	28500	8700

5.2. In a metric airspace

VFR Flight					
Track from 0° to 179°			Track from 180° to 359°		
Standard Metric	Meter	Feet	Standard Metric	Meter	Feet
105	1050	3500	135	1350	4400
165	1650	5400	195	1950	6400
225	2250	7400	255	2550	8400
285	2850	9400	315	3150	10300
345	3450	11300	435	4350	12300
405	4050	13300	495	4950	14300
465	4650	15300	555	5550	16200
525	5250	17200	615	6150	18200
585	5850	19200	675	6750	20200
645	6450	21200	735	7350	22100
705	7050	23100	795	7950	24100
765	7650	25100	855	8550	26100
825	8250	27100			



JOINING THE AERODROME CIRCUIT

1. Introduction

A procedure has been adopted for any light aircraft approaching to land at an airfield. This procedure is joining the standard aerodrome traffic circuit and is adopted by convention rather than laid down by regulation.
There is no standardized manner to join the aerodrome circuit. This document will present you a basic integration manner extracted from several countries regulations all around the world.

The circuit requires that an aircraft should track over at least three legs of a rectangular course aligned with the runway or landing strip which is most into-wind, except when the air traffic controller gives a straight-in approach or an indirect approach clearance.

These 3 legs are:

- Downwind leg
- Base leg
- Final leg

The reader of this document must know the basics of an aerodrome circuit construction.

2. Basic security rules

Operating on and in the vicinity of an aerodrome requires the pilot to observe other traffic for the purpose of avoiding collision and, unless instructed by ATC, conform with or avoid the aerodrome traffic circuit formed by other aircraft.

The standard overhead joining procedure is a recommended means of complying with this rule, by being 500 feet to 1000ft above aerodrome traffic pattern altitude and then sequencing appropriately.

Pay attention that some national regulations require 500ft minimum but others shall require 1000ft minimum above aerodrome traffic circuit. Please consult you national regulations in order to have the adequate altitude.

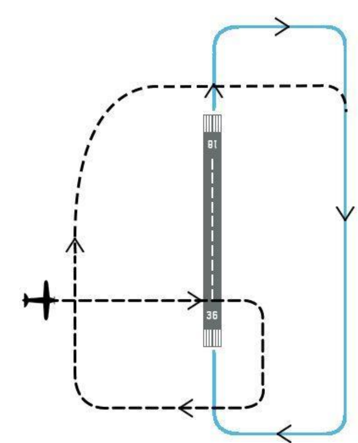
This procedure gives the opportunity to carefully check the airfield area, the air sock and boundaries for hazards – animals, power lines and other wires, ditches, obstructions - and to ascertain the whereabouts of other traffic in, or joining, the circuit and to be seen by them.

If the circuit altitude is not published, or not known by the pilot, **the pilot must take 1000ft AGL as standard altitude** for his aerodrome circuit.

3. Joining the circuit on non-controlled airfield

3.1. Aircraft arriving at the opposite side of the circuit – standard

In this configuration, the pilot is at the opposite side of the circuit pattern and flies directly overhead the runway or airfield; he will cross the runway axis before the circuit. Remind you that the altitude taken must **be 500 to 1000 feet above aerodrome traffic circuit altitude** (take 1500ft AGL as traffic circuit altitude if there is no published pattern altitude).



When overhead, the pilot shall not join the downwind directly. The pilot must do a 180° turn outside the runway if possible, and then follows a parallel track outside the runway axis and at the opposite side of the circuit in order to let traffic perform their flight in the aerodrome circuit.

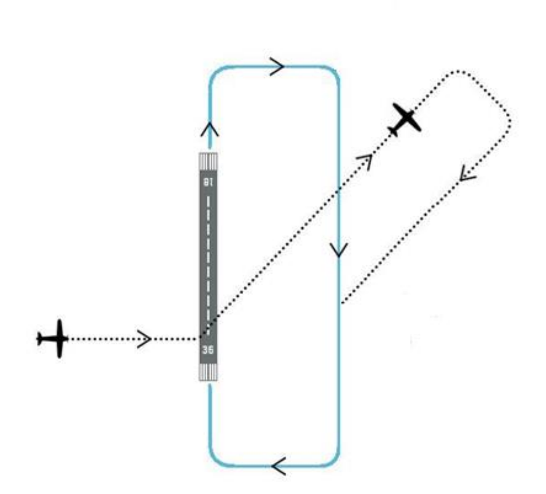
When the runway is behind the aircraft and in function of nearby traffic in the circuit, **the pilot must descend to the aerodrome circuit altitude in function of traffic and can join the beginning of the downwind leg.**

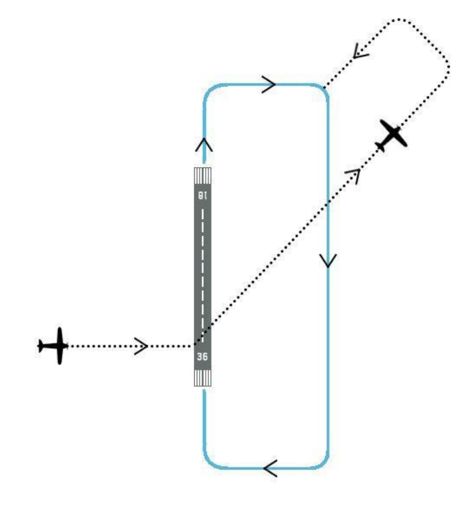
3.2. Aircraft arriving at the opposite side of the circuit – 45° procedure

In this configuration, the pilot is at the opposite side of the circuit pattern and flies directly overhead the runway or airfield; he will cross the runway axis before the circuit. Remind you that the altitude taken must **be 500 to 1000 feet above aerodrome traffic pattern altitude** or 1500ft AGL if there is no published pattern altitude.

When overhead, the pilot shall not join the downwind directly. The pilot must do a 45° turn inside the aerodrome circuit in order to let traffic perform their flight in the aerodrome circuit. The 45° turn must be done in the direction of the beginning of the downwind leg.

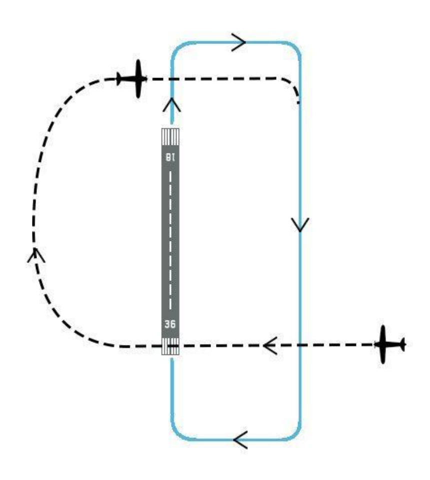
When the beginning of the downwind leg is behind the aircraft and in function of nearby traffic in the circuit, the **pilot must descend to the aerodrome circuit altitude in function of traffic and can join the beginning or the middle of the downwind leg.**





3.3. Aircraft inside of the circuit before airfield overhead – standard

In this configuration, the pilot will join the overhead inside the circuit pattern and flies directly overhead the runway or airfield. Remind you that the altitude taken must **be 500 to 1000 feet above aerodrome traffic pattern altitude** or 1500ft AGL if there is no published pattern altitude.

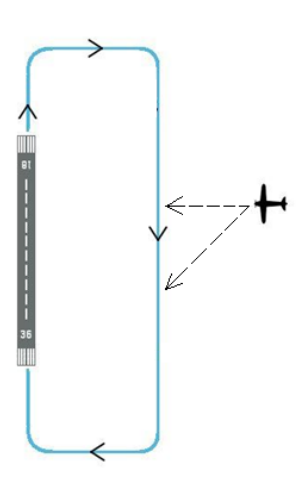


When overhead, the pilot shall not join the downwind directly. The pilot must do a 90° turn outside the runway if possible, and then follows a parallel track outside the runway axis and at the opposite side of the circuit in order to let traffic perform their flight in the aerodrome circuit.

When the runway is behind the aircraft and in function of nearby traffic in the circuit, **the pilot must descend to the aerodrome circuit altitude in function of traffic and can now join the beginning of the downwind leg.**

3.4. Aircraft inside of the circuit before airfield overhead – 45°/90° procedure

The runway is in front of the aircraft and in function of nearby traffic in the circuit, **the pilot must descend to the aerodrome circuit altitude in function of traffic and can now join the middle of the downwind.**



The integration can be at the middle of the downwind using a 45° or 90° angle.

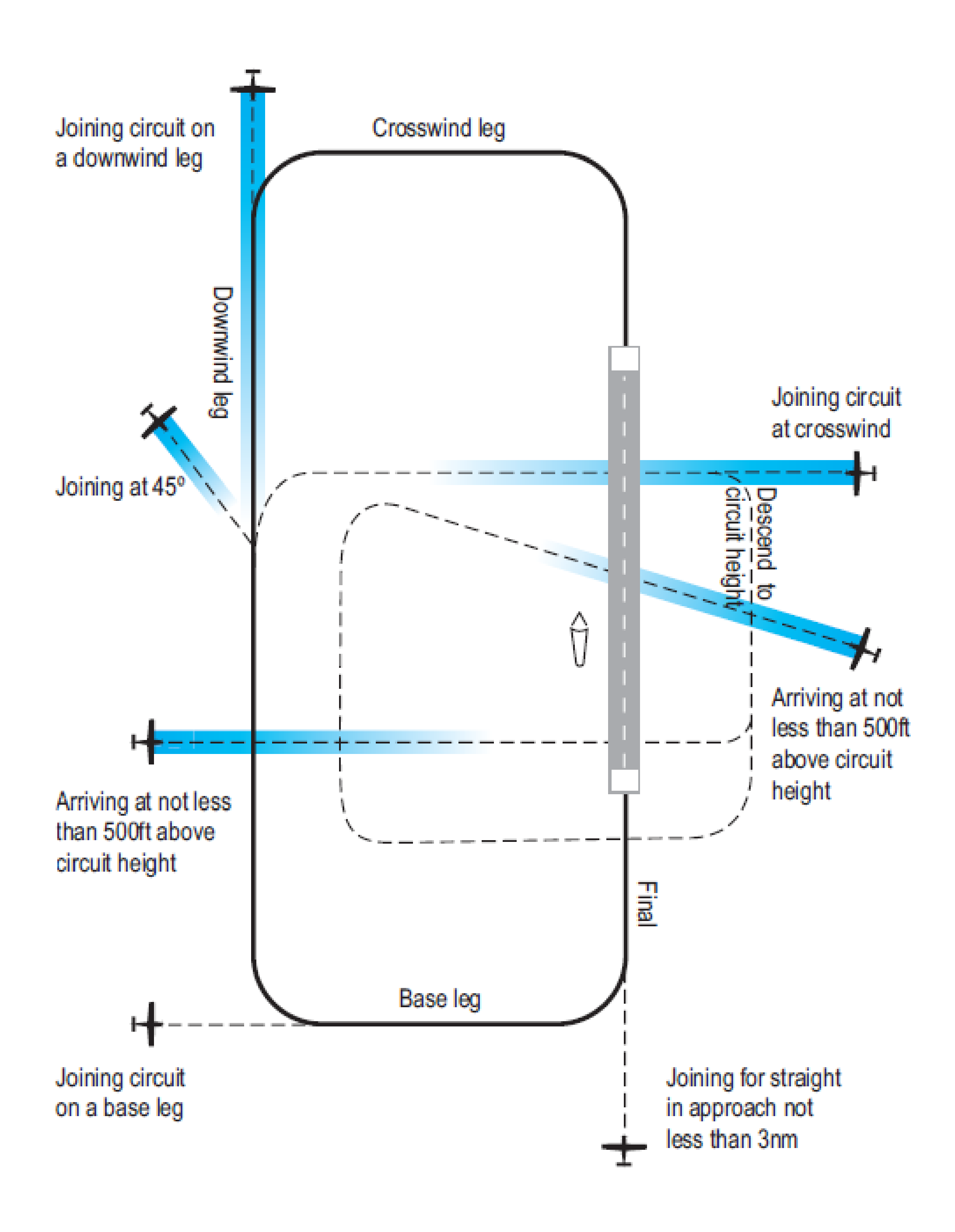
This 45° integration type can be the default integration manner in some countries (like in the USA).

4. Joining the circuit at controlled airfields

At controlled airfields, the pilot should follow the instructions of the air traffic controller.

As a pilot, you must call the air traffic controller 2 minutes before joining the aerodrome circuit.
The air traffic controller can instruct you to join the aerodrome circuit everywhere even if not published.

The air traffic controller can give you one of the integration solutions shown on the image below.





VFR TOP OF DESCENT CALCULATION

1. Introduction

The top of descent or TOD is the point for an aircraft to initiate a descent to a lower lever for arrival at the destination airfield. The aircraft is leaving the cruise phase of the flight and start a descent phase to the first approach altitude expected over an aerodrome circuit, a landmark or entry VFR points.

1.1. Angle of descent rate

The standard descent is calculated along a 3° descent angle :

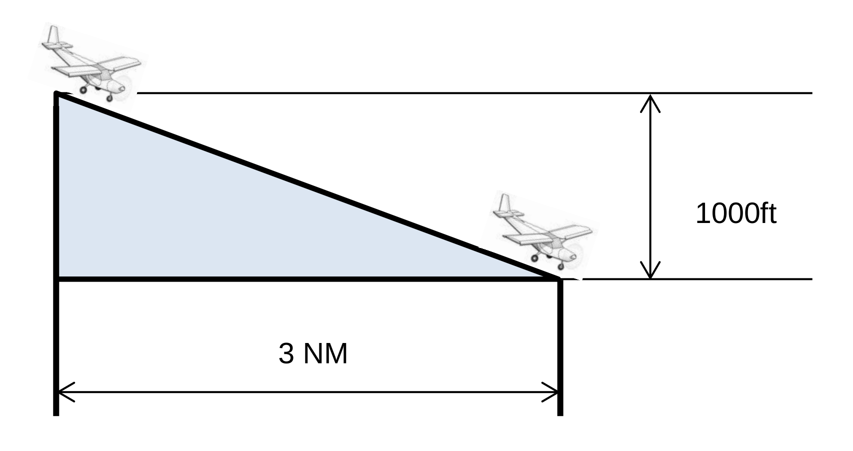
- Descent angle (°) ≈ descent rate (%) x 0.6
- Rate (ft/NM) ≈ 60 x Rate (%) ➔ 1% descent rate = 60ft/NM
- Rate (ft/NM) ≈ 100 x Rate (°) ➔ 1° descent angle = 100ft/NM

1.2. Rule of 3

In aviation, pilots adopted a formula to assure a slow, based on a 3° descent rate, steady and comfortable descent: the rule of three or "3:1 rule of descent".

This rule implies 3 NM of travel should be allowed for every 1,000 feet (300 m) of descent.

The "rule of 3" is used by pilots flying small aircraft as well as by those flying airliners.



2. Top of descent (TOD) calculation

2.1. Top of descent calculation (for light VFR)

For a light VFR aircraft, the usual descent rate can be taken as -500ft/min.
That means you will lose 500ft in 1 minute.

Using this rate in feet/min, you can easily calculate the top of descent time.

Time_before_arrival (min) = (Altitude to loose /descent_rate (ft/min)

Example:
An aircraft is at 3500ft and I need to join the aerodrome circuit at 1500ft. Aircraft needs to loose 2000ft and will use -500ft/min vertical speed.
Time before arrival = 2000/500 = 4 min. The pilot now knows that he must start his descent 4min before joining the circuit.
(In order to make a quick calculation, round your altitude to the nearest 500ft. (example: for 3300ft, you will take 3500ft))

For a light VFR aircraft, the usual cruising speed is around 120kt. That means, you travel 2NM each minute or 30 seconds flight each 1NM.

If the pilot wants the distance calculation, we can use this basic calculation

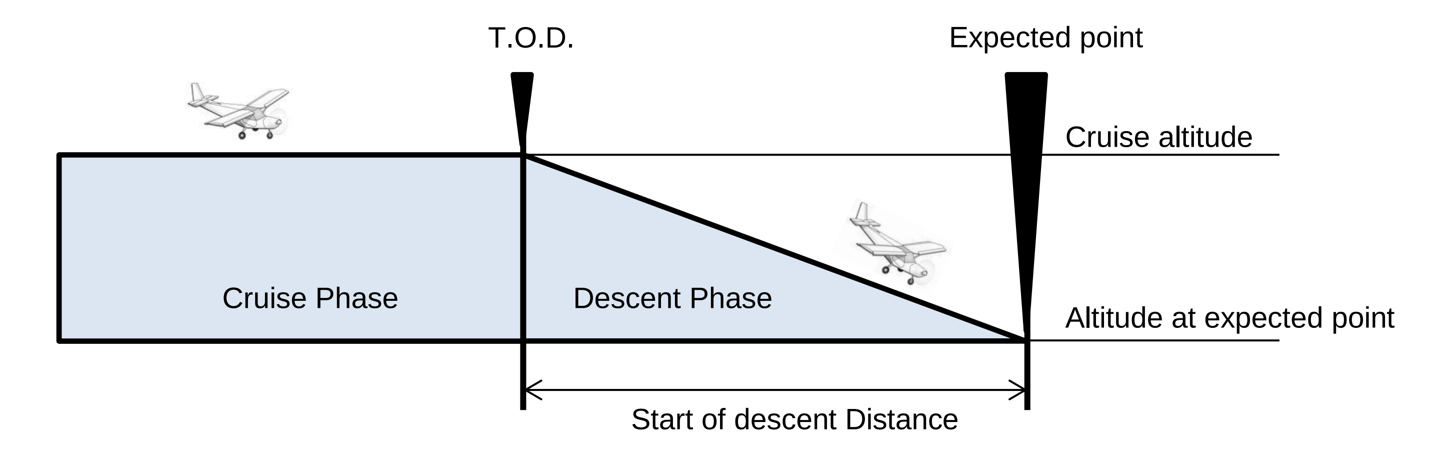
Factor (min/NM) = 60/TAS ➔ Factor_inv (NM/min) = TAS/60
Distance = Factor_inv x Time_before_arrival

If the aircraft altitude is low (below 5000ft), you can take the approximation TAS = IAS.

Example:
The pilot knows that he must start his descent 4min before joining the circuit, his altitude is 3500ft and speed 120kt
Distance = (120/60) x 4 = 8 NM
The pilot shall start about 8NM from the circuit or destination airfield.

2.2. Distance based top of descent calculation

A more complex calculation can be used for VFR flight using aircraft which can fly at an altitude over FL100 and/or the speed is greater than 150kt.



$$\textit{Start of descent Distance}\ (NM) = \frac{(Altitude_{cruise} - Altitude_{expected_point})/100}{Descent_{angle}}$$

Example:
We are flying at 5500ft
We need to descent to next point at 1500ft at standard rate **3**°.
D (NM) = (5500-1500)/100 / 3° = 40/3 = 13.3 NM
Result is that we shall start the descent around 13NM before the expected point.

3. Descent rate calculation

If you want to descent using a **3°** descent path and you expect a vertical speed in feet per minute to set the value on your autopilot panel, you must use the calculation below using the ground speed.

Vertical speed (ft/min) = Descent rate (%) x Ground speed (knots)

Example:
Ground speed is 110kt, and descent rate is standard 5%.
Note that the descent rate value can be approximated using only 5% instead of 5.2% to ease the calculation.
Vertical speed = 5 x 110 = 550ft/min,
(if we use 5.2% instead, vertical speed will be 572 ft/min ➔ less than 5% error).

But this formula has some restrictions:

- Ground speed in some aircraft is not known because the wind is not known
- Ground speed can change during descent if this speed is not maintained constant.

You need to estimate your ground speed for this calculation.



TRAFFIC PATTERN DESCRIPTION

1. Introduction

An aerodrome traffic pattern is used by VFR traffic for training purposes or to prepare the aircraft for landing operation. Normally this pattern has a rectangular shape.

Some traffic pattern specific details may be published on a Visual Approach Chart (VAC) of the aerodrome.

2. General presentation

2.1. Standard circuit parameters

The standard circuit pattern is **left hand pattern** where all **90° turn** are taken to the **left**. When you don't have any information about circuit pattern orientation, it will be preferable to choose left handed pattern if you can't get any information from ATS service.

The standard circuit parameters are:

- All turn angles are **90°**
- All **turns** shall be taken to the **left**: that's left hand circuit
- The circuit shall be performed at **1000ft above the ground (AGL)** or airfield elevation.

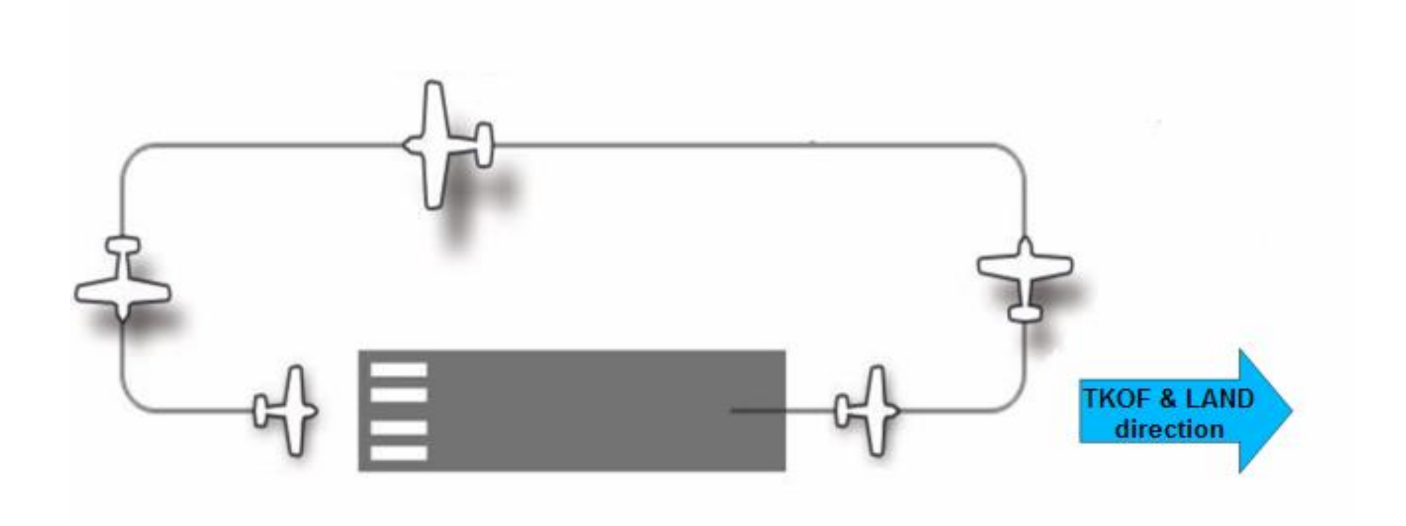


Figure: basic left hand pattern

You **must** use the general parameters when:

- You have no charts of the airfield
- Some parameters are not published on charts

2.2. Parameters published on charts

Be careful, sometimes on charts, all or part of the parameters can be published:

- Circuit pattern form (angles of turn on some legs) cannot always be rectangular
- Turn orientation can be left, right or both.
- Specific Altitude or height (AMSL or AGL) can be different than 1000ft AGL
- Specific touchdown points

Some situations, such as terrain, noise-sensitive areas, cities, natural parks, require all turns in the aerodrome traffic circuit to be made to the right. This is then called a right hand pattern.

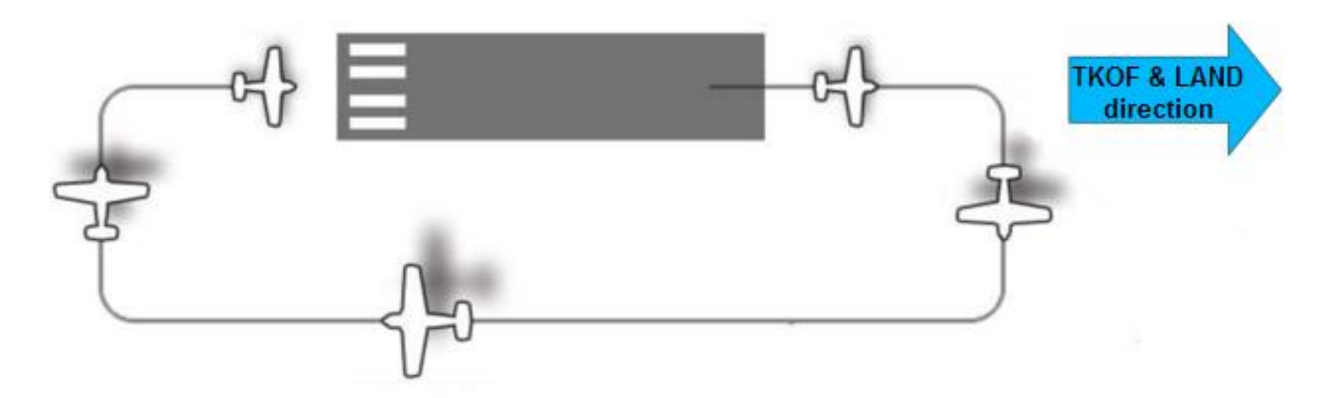


Figure: basic right hand circuit

It is not unusual to find a runway served by a standard (left) pattern when used in the one direction and by a right hand pattern in the opposite direction, thus the pattern will always be on the same side of the runway.

Since left-hand circuit is standard, the words "left hand" will normally not be used. To differentiate with the non-standard right-hand circuit, always the words "right-hand" will be used when proceeding in a right-hand visual circuit.

ATC:"D-ECHO, enter downwind runway 34" This will be the left downwind of the runway.
ATC:"D-ECHO, enter right downwind runway 34" This will be the right downwind of the runway.

3. Circuit pattern legs

A circuit pattern is divided into different legs:

- Upwind leg
- Crosswind leg
- Downwind leg
- Base leg
- Final

This chapter will study the circuit pattern legs with a light aircraft (step for step).

3.1. Upwind leg

The upwind leg begins at the point where the airplane leaves the ground.

The purpose of this leg for the aircraft is climbing at safe altitude greater than 500ft AGL, then at the pattern altitude

It continues climbing straight ahead to gain sufficient altitude before the 90-degree turn to the crosswind leg.

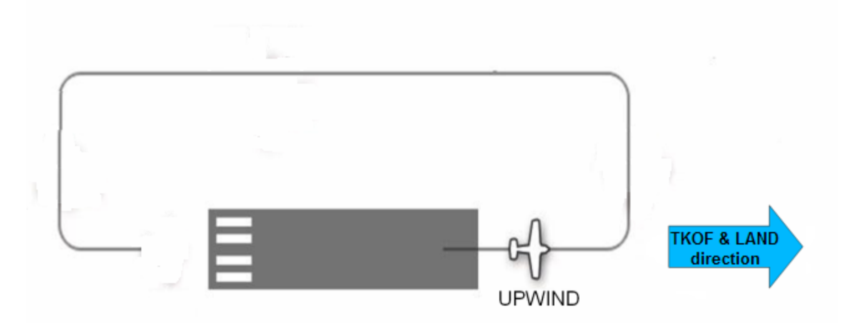


Figure: upwind leg for left hand circuit

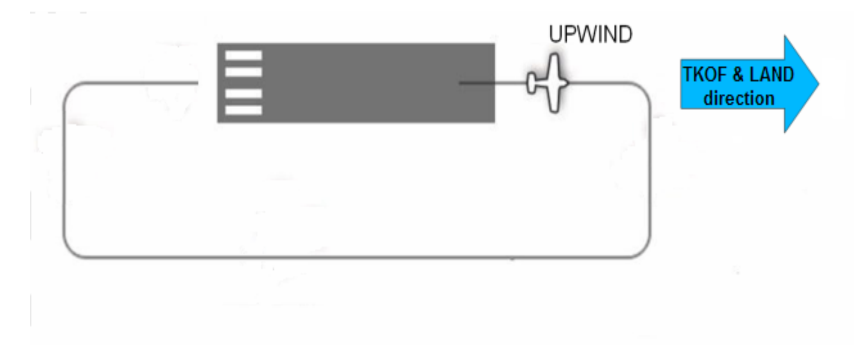


Figure: upwind leg for right hand circuit

3.2. Crosswind leg

The first 90° turn will place the plane under a perpendicular route from the runway axis: it's **the crosswind leg**. Except in special cases, this turn shall not be performed before 500ft AGL.

You are now entering the traffic side of the circuit: watch for aircraft joining the circuit on crosswind or on beginning of downwind.

The crosswind leg is a flight path at a 90° angle to the take-off direction. After making a left turn from the upwind leg one enters the crosswind leg. This turn is made at a safe height, while the climb is continued towards the indicated or cleared circuit altitude.

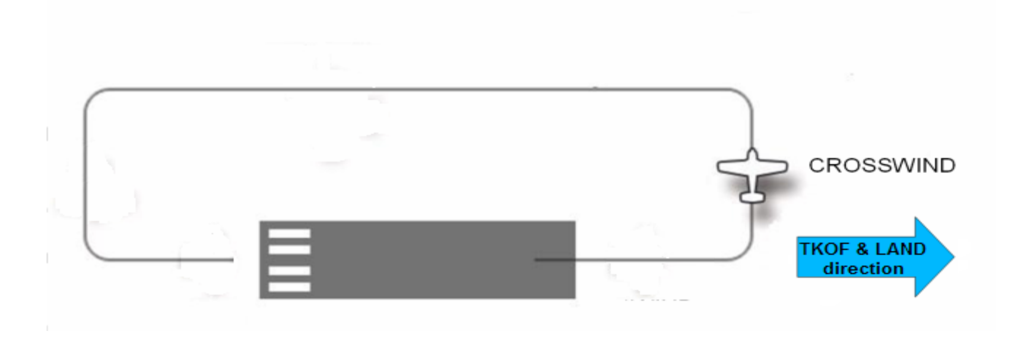


Figure: crosswind leg for left hand circuit



Figure: crosswind leg for right hand circuit

3.3. Downwind leg

The second 90° turn will place the plane under a parallel route from the runway axis: it's **the downwind leg.**

Except when the circuit altitude is published, this leg is performed at 1000ft AGL at about 1NM to 2NM distance from the runway.

The downwind leg will be flown at moderate speed, adjusted to avoid overtaking preceding aircraft, and holding a constant height.

The downwind leg is a flight path at a 180° angle (opposite) to the take-off direction.

The pilot must check the crosswind drift against selected landmarks and adjust heading to track parallel to the runway, perform the appropriate downwind cockpit checks and hold altitude and appropriate traffic spacing.

He must set adequate power and trim the aircraft to maintain an airspeed which allows time to plan the landing without unnecessarily delaying other traffic – probably around 1.7 × V_{so}.

In this branch, the pilot shall prepare his plane in approach configuration for landing.

The pilot shall maintain his flight direction with outside landmarks and keep the runway in sight.

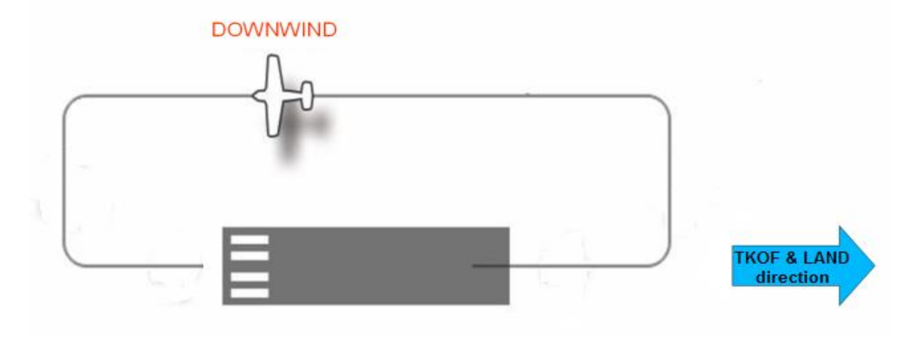


Figure: downwind leg for left hand circuit



Figure: downwind leg for right hand circuit

When reaching the point when you are overtaking the runway's threshold, the pilot shall **extend the downwind about 1.6NM** (it shall be reduced to 1NM for training).

3.4. Base leg

The third 90° turn will place the plane under a perpendicular route from the runway axis: it's **the base leg**. The pilot shall perform this turn when the runway threshold is in sight with about 45° rear angle.

The base leg is a flight path at a 90° angle to the landing runway direction and connects the downwind leg to the final approach leg. During base leg, **the pilot initiates the descent to reach about 700ft AGL** at the end of the leg.

The pilot holds airspeed but reduces power so that a descent is started.

He lowers the first stage flap if so equipped, then he reduces airspeed [but not less than 1.5 × Vso] and trim.

The time spent flying the base leg is most important, providing the opportunity to set up the aircraft in the approach attitude:

- **to establish a power and flap setting** [and trim] for the required rate of descent
- **to check for conflicting traffic** both airborne and on the ground and particularly any traffic on a straight-in approach or very wide circuit;
- **to assess the crosswind component** along the landing path
- **to decide the touchdown technique** appropriate for the conditions and to review the pre-landing checks.



Figure: base leg for left hand circuit



Figure: base leg for right hand circuit

3.5. Final

The last 90° turn will place the plane on the runway axis in order to land on the runway: it's the final. This turn shall normally be performed to reach 500ft AGL when finished.

The final approach leg is a flight path in the direction of landing from the base leg to the runway.

During final, the pilot prepares his plane for landing: **flaps configuration, speed near 1.3 x Vso** (stall speed).

Don't forget to extend the gear if needed!



Figure: final for left hand circuit

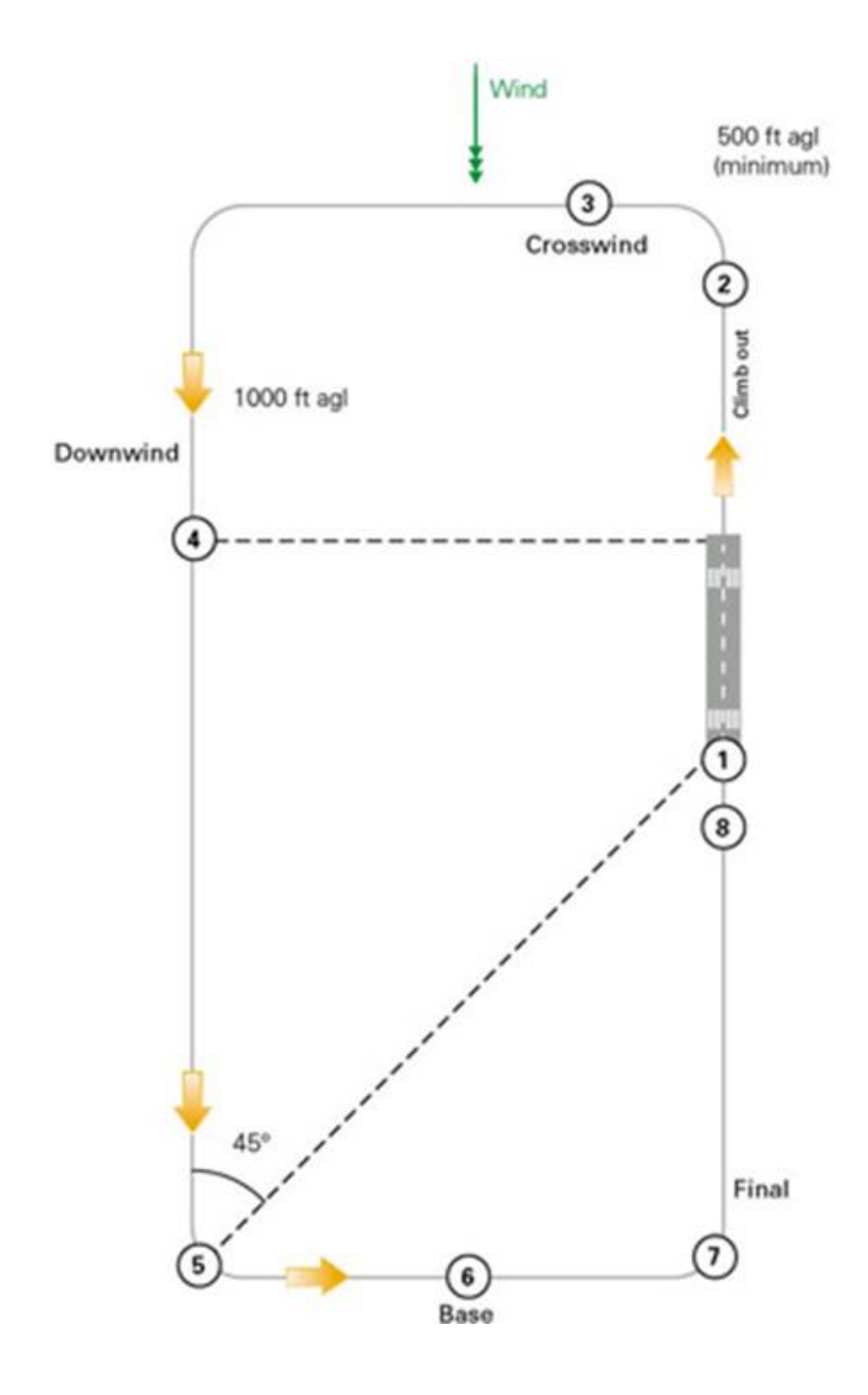


Figure: final for right hand circuit

4. Summary of circuit

Hereunder you will find all the circuit parameters:

1. Take off point on the runway
2. End of climb out on upwind leg
3. Crosswind leg
4. Downwind leg
5. Turning on base leg (end of downwind)
6. Base leg
7. Turning on final (end of base leg)
8. Short final



VFR AERONAUTICAL CHART SYMBOLS

AERONAUTICAL INFORMATION

TOPOGRAPHIC INFORMATION

CULTURE

HYDROGRAPHY

RELIEF

HELICOPTER ROUTE CHARTS

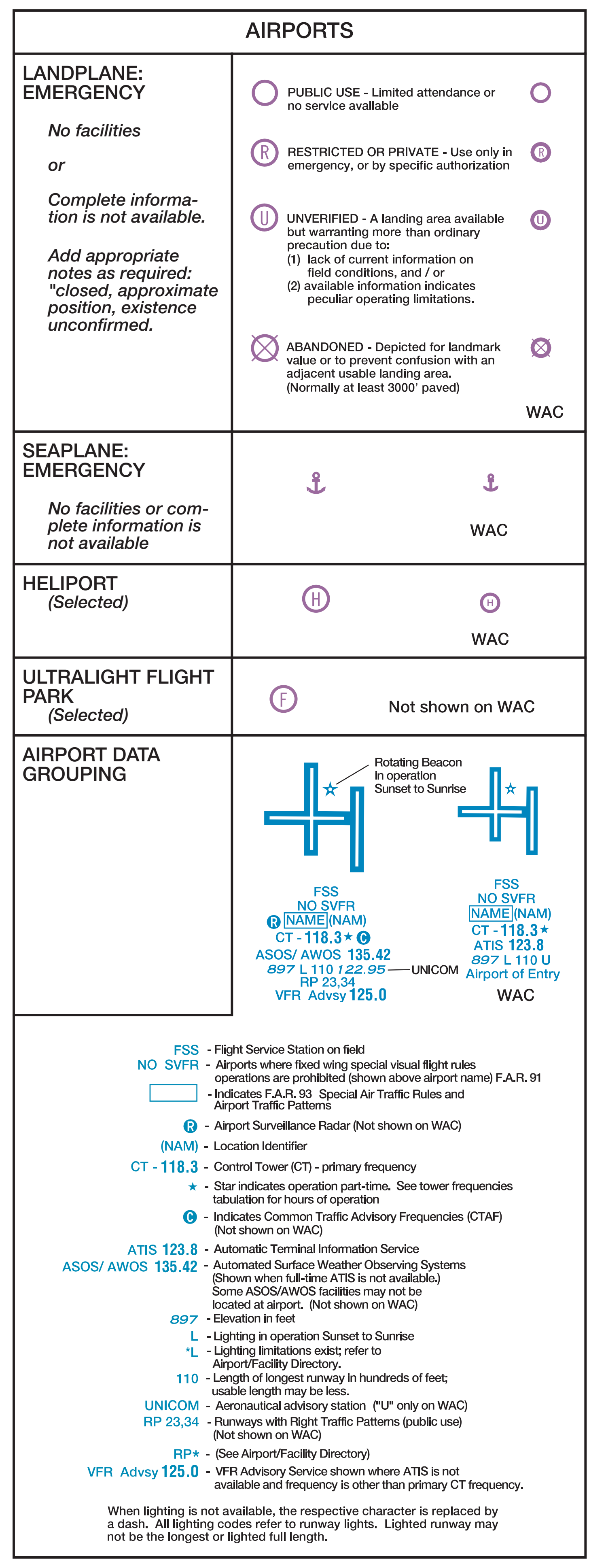
VFR FLYWAY PLANNING CHARTS

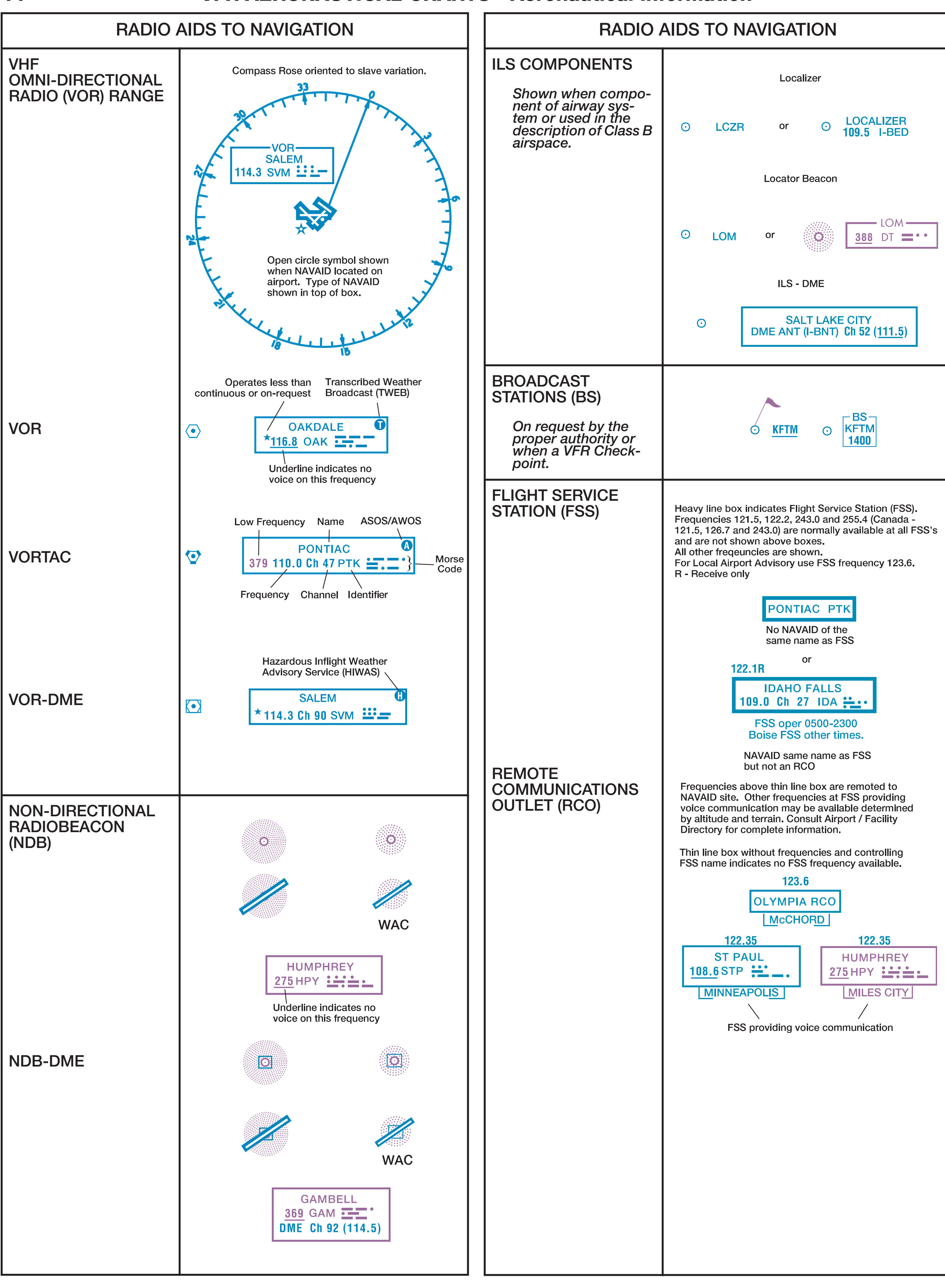
GENERAL INFORMATION

Symbols shown are for World Aeronautical Charts (WAC), Sectional aeronautical charts and Terminal Area Charts (TAC). When a symbol is different on any VFR chart series, it will be annotated thus:
WAC or Not shown on WAC.

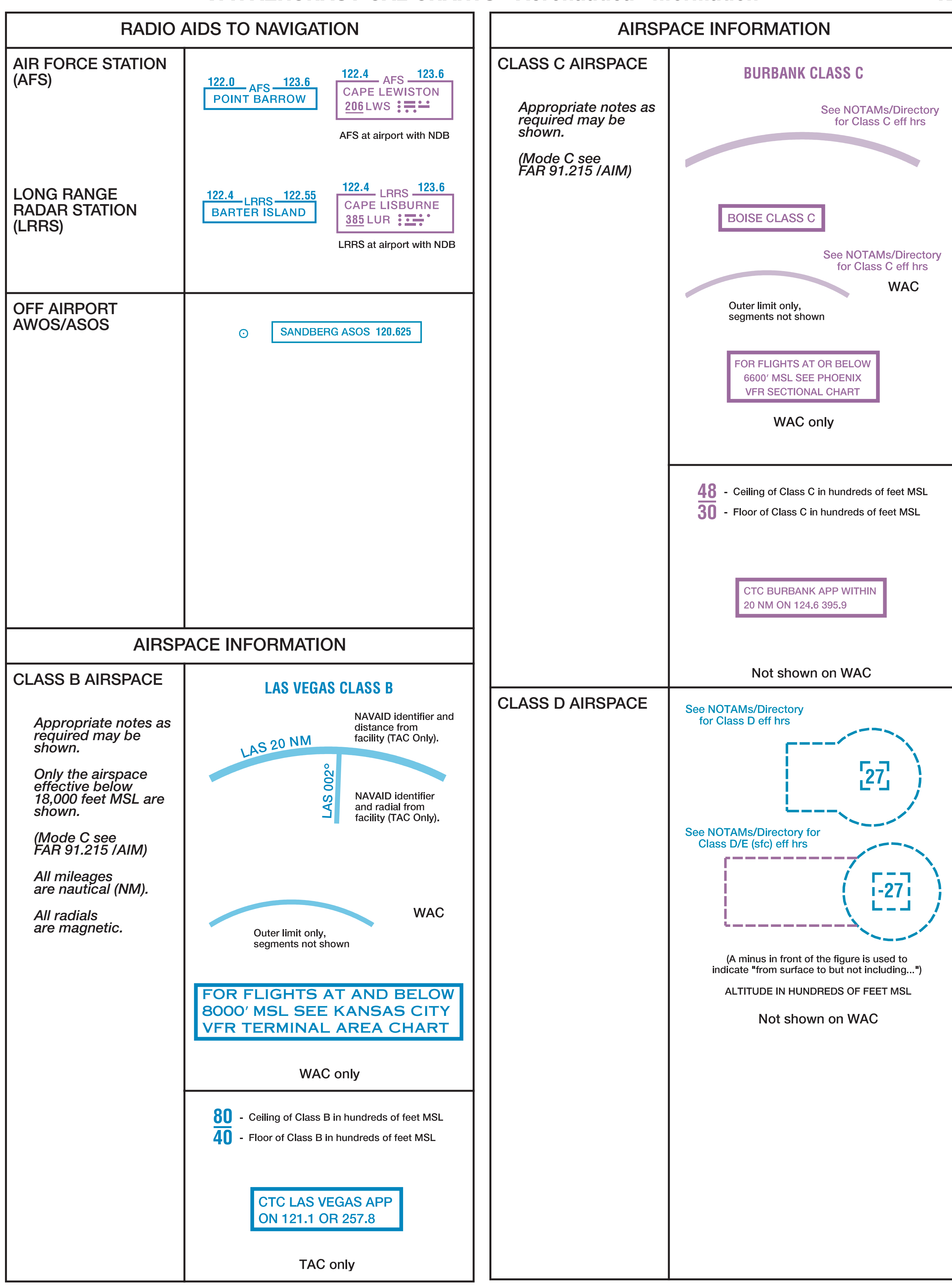
AIRPORTS

AIRPORTS	
LANDPLANE: CIVIL *Airports having control towers (CT) are shown in blue, all others are shown in magenta.* *All recognizable runways, including some which may be closed, are shown for visual identification purposes.* *Refueling and repair facilities for normal traffic.* *Runway patterns will be depicted at airports with at least one hard surface runway 1500´ or greater in length.*	WAC
SEAPLANE: CIVIL	WAC
LANDPLANE: CIVIL-MILITARY	WAC
LANDPLANE: MILITARY *Refueling and repair facilities not indicated.*	WAC





RADIO AIDS TO NAVIGATION
VHF OMNI-DIRECTIONAL RADIO (VOR) RANGE
Compass Rose oriented to slave variation.
VOR SALEM 114.3 SVM
Open circle symbol shown when NAVAID located on airport. Type of NAVAID shown in top of box.
VOR
Operates less than continuous or on-request
Transcribed Weather Broadcast (TWEB)
OAKDALE
116.8 OAK
Underline indicates no voice on this frequency
VORTAC
Low Frequency
Name
ASOS/AWOS
PONTIAC
379 110.0 Ch 47 PTK
Morse Code
Frequency
Channel
Identifier
VOR-DME
Hazardous Inflight Weather Advisory Service (HIWAS)
SALEM
114.3 Ch 90 SVM
NON-DIRECTIONAL RADIOBEACON (NDB)
WAC
HUMPHREY
275 HPY
Underline indicates no voice on this frequency
NDB-DME
WAC
GAMBELL
369 GAM
DME Ch 92 (114.5)
RADIO AIDS TO NAVIGATION
ILS COMPONENTS
Shown when component of airway system or used in the description of Class B airspace.
Localizer
LCZR
or
LOCALIZER 109.5 I-BED
Locator Beacon
LOM
or
LOM 388 DT
ILS - DME
SALT LAKE CITY
DME ANT (I-BNT) Ch 52 (111.5)
BROADCAST STATIONS (BS)
On request by the proper authority or when a VFR Checkpoint.
KFTM
BS KFTM 1400
FLIGHT SERVICE STATION (FSS)
Heavy line box indicates Flight Service Station (FSS). Frequencies 121.5, 122.2, 243.0 and 255.4 (Canada - 121.5, 126.7 and 243.0) are normally available at all FSS's and are not shown above boxes.
All other freqeuncies are shown.
For Local Airport Advisory use FSS frequency 123.6.
R - Receive only
PONTIAC PTK
No NAVAID of the same name as FSS
or
122.1R
IDAHO FALLS
109.0 Ch 27 IDA
FSS oper 0500-2300
Boise FSS other times.
NAVAID same name as FSS but not an RCO
REMOTE COMMUNICATIONS OUTLET (RCO)
Frequencies above thin line box are remoted to NAVAID site. Other frequencies at FSS providing voice communication may be available determined by altitude and terrain. Consult Airport / Facility Directory for complete information.
Thin line box without frequencies and controlling FSS name indicates no FSS frequency available.
123.6
OLYMPIA RCO
McCHORD
122.35
ST PAUL
108.6 STP
MINNEAPOLIS
122.35
HUMPHREY
275 HPY
MILES CITY
FSS providing voice communication


RADIO AIDS TO NAVIGATION
AIR FORCE STATION (AFS)
122.0 AFS 123.6
POINT BARROW
122.4 AFS 123.6
CAPE LEWISTON
206 LWS
AFS at airport with NDB
LONG RANGE RADAR STATION (LRRS)
122.4 LRRS 122.55
BARTER ISLAND
122.4 LRRS 123.6
CAPE LISBURNE
385 LUR
LRRS at airport with NDB
OFF AIRPORT AWOS/ASOS
SANDBERG ASOS 120.625
AIRSPACE INFORMATION
CLASS B AIRSPACE
Appropriate notes as required may be shown.
Only the airspace effective below 18,000 feet MSL are shown.
(Mode C see FAR 91.215 /AIM)
All mileages are nautical (NM).
All radials are magnetic.
LAS VEGAS CLASS B
NAVAID identifier and distance from facility (TAC Only).
LAS 20 NM
LAS 002°
NAVAID identifier and radial from facility (TAC Only).
WAC
Outer limit only, segments not shown
FOR FLIGHTS AT AND BELOW 8000' MSL SEE KANSAS CITY VFR TERMINAL AREA CHART
WAC only
80 - Ceiling of Class B in hundreds of feet MSL
40 - Floor of Class B in hundreds of feet MSL
CTC LAS VEGAS APP ON 121.1 OR 257.8
TAC only
AIRSPACE INFORMATION
CLASS C AIRSPACE
Appropriate notes as required may be shown.
(Mode C see FAR 91.215 /AIM)
BURBANK CLASS C
See NOTAMs/Directory for Class C eff hrs
BOISE CLASS C
See NOTAMs/Directory for Class C eff hrs
WAC
Outer limit only, segments not shown
FOR FLIGHTS AT OR BELOW 6600' MSL SEE PHOENIX VFR SECTIONAL CHART
WAC only
48 - Ceiling of Class C in hundreds of feet MSL
30 - Floor of Class C in hundreds of feet MSL
CTC BURBANK APP WITHIN 20 NM ON 124.6 395.9
Not shown on WAC
CLASS D AIRSPACE
See NOTAMs/Directory for Class D eff hrs
27
See NOTAMs/Directory for Class D/E (sfc) eff hrs
-27
(A minus in front of the figure is used to indicate "from surface to but not including...")
ALTITUDE IN HUNDREDS OF FEET MSL
Not shown on WAC

AIRSPACE INFORMATION

CLASS E AIRSPACE

The limits of Class E airspace shall be shown by narrow vignettes or by the dashed magenta symbol. Individual units of designated airspace are not necessarily shown; instead, the aggregate lateral and vertical limits shall be defined by the following:

Airspace beginning at the surface (sfc) designated around airports ...

Airspace beginning at 700 feet AGL ...

Airspace beginning at 1200 feet AGL or greater that abuts uncontrolled airspace (Class G) ...

Differentiates floors of airspace greater than 700 feet above the surface...

When the ceiling is less than 18,000 feet MSL, the value, prefixed by the word "ceiling," shall be shown along the limits.

Not shown on WAC

OFFSHORE CONTROL AREAS

AIRSPACE INFORMATION

CANADIAN AIRSPACE

Individual units of designated Canadian airspace are not necessarily shown; instead, the aggregate lateral and vertical limits shall be portrayed as closely as possible to the comparable U.S. airspace.

Appropriate notes as required may be shown.

Not shown on WAC

AIRSPACE CLASSIFICATION (SEE CANADA FLIGHT SUPPLEMENT) AND OPERATIONAL REQUIREMENTS (SEE DOD AREA PLANNING AP/1) MAY DIFFER BETWEEN CANADA AND UNITED STATES

NOTE: REFER TO CURRENT CANADIAN CHARTS AND FLIGHT INFORMATION PUBLICATIONS FOR INFORMATION WITHIN CANADIAN AIRSPACE

AIRSPACE OUTSIDE OF U.S.

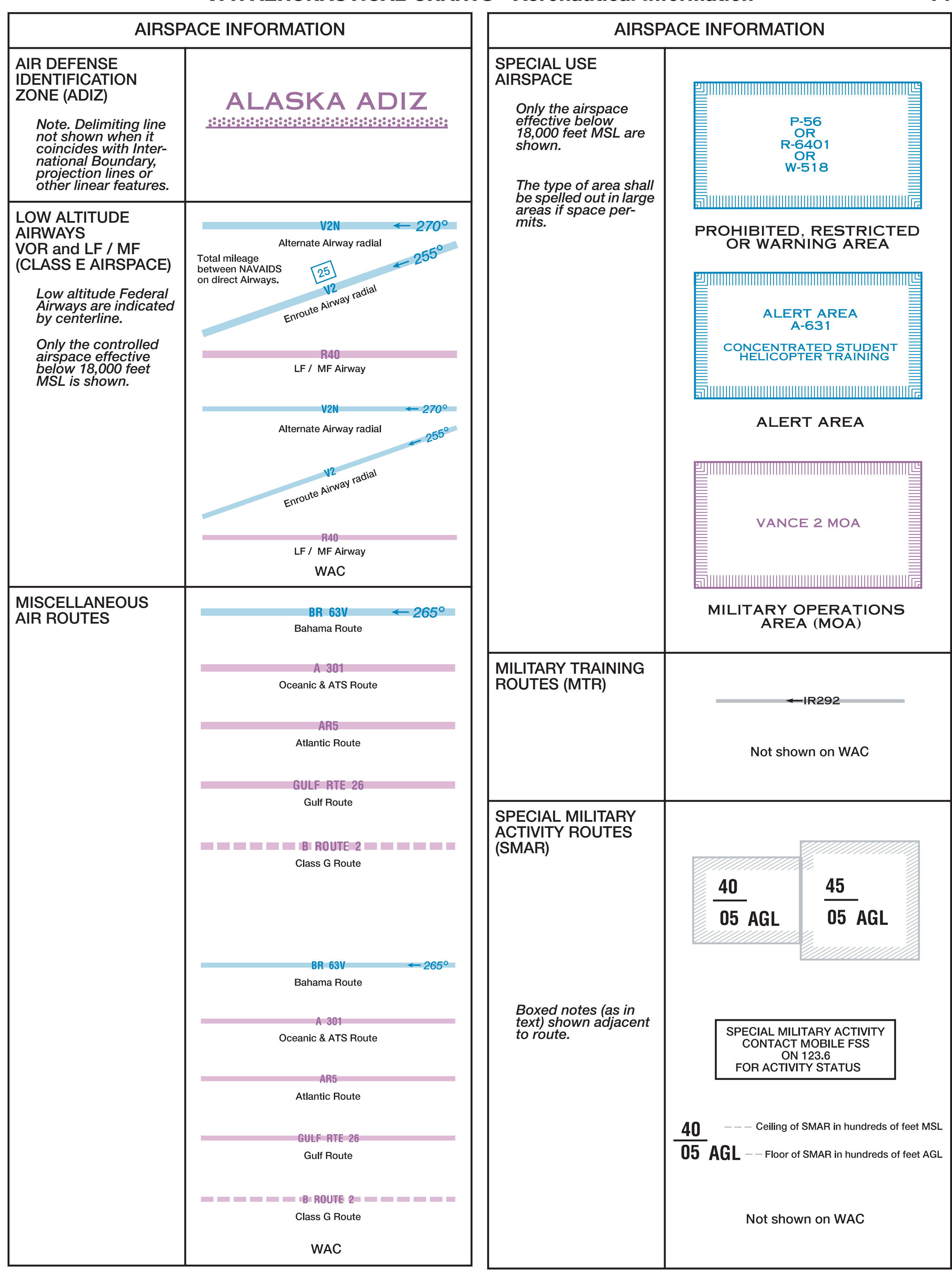
Other than Canada

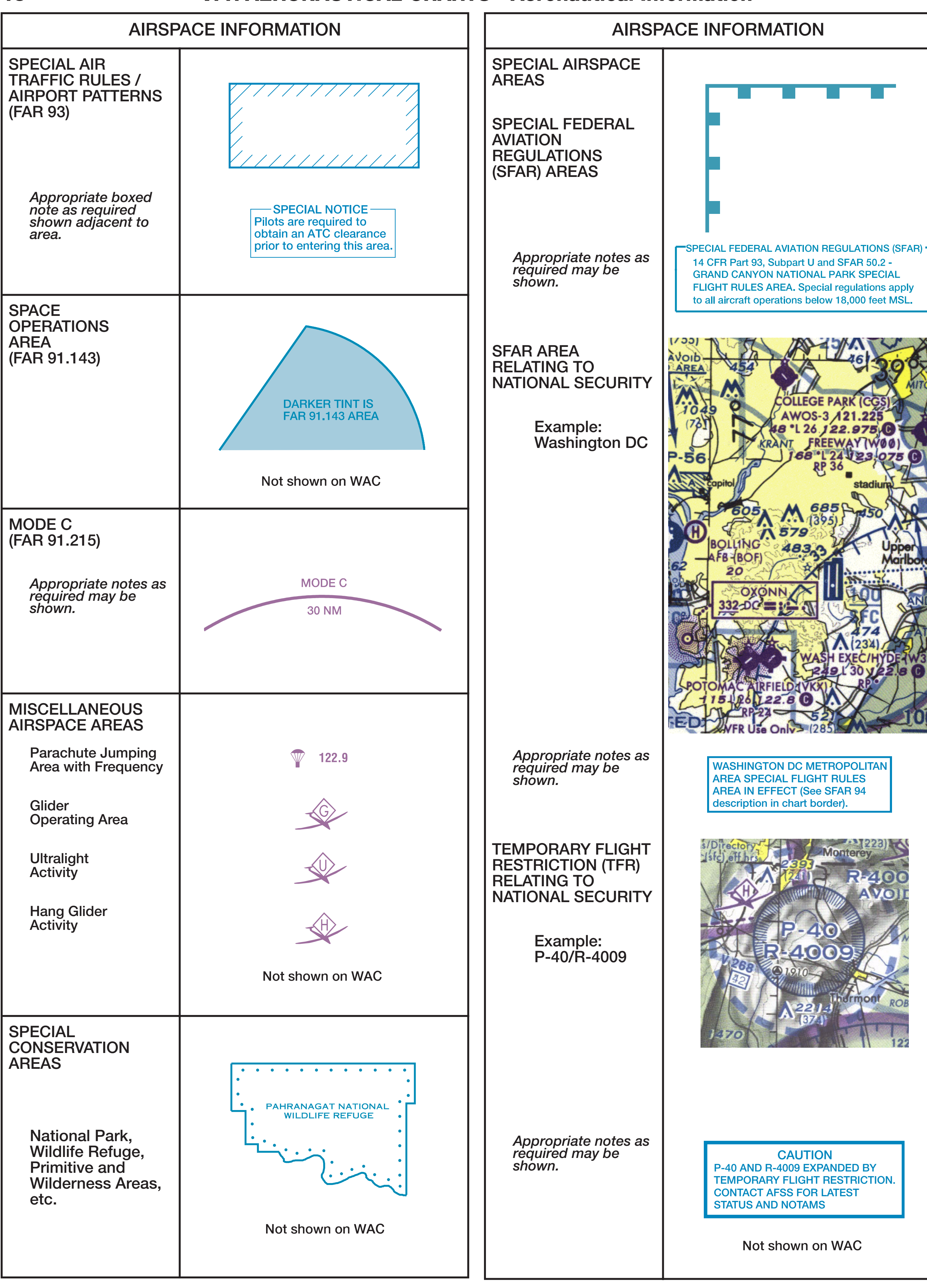
Appropriate notes as required may be shown.

NOTE: REFER TO CURRENT DOD (NGA) FLIGHT INFORMATION PUBLICATIONS FOR INFORMATION OUTSIDE OF U.S. AIRSPACE

FLIGHT INFORMATION REGIONS (FIR) and /or (CTA)

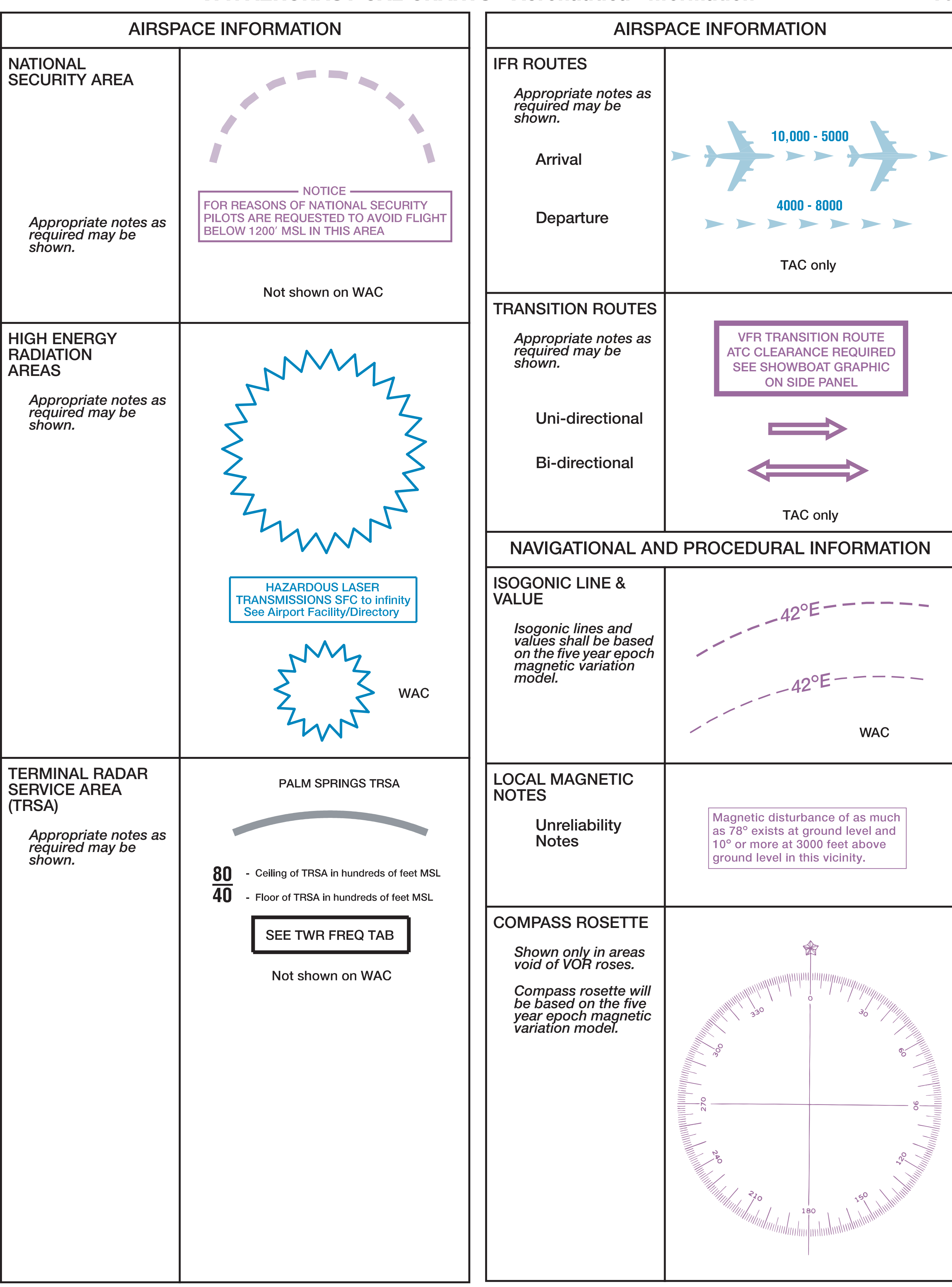
OCEANIC CONTROL AREAS (OCA)

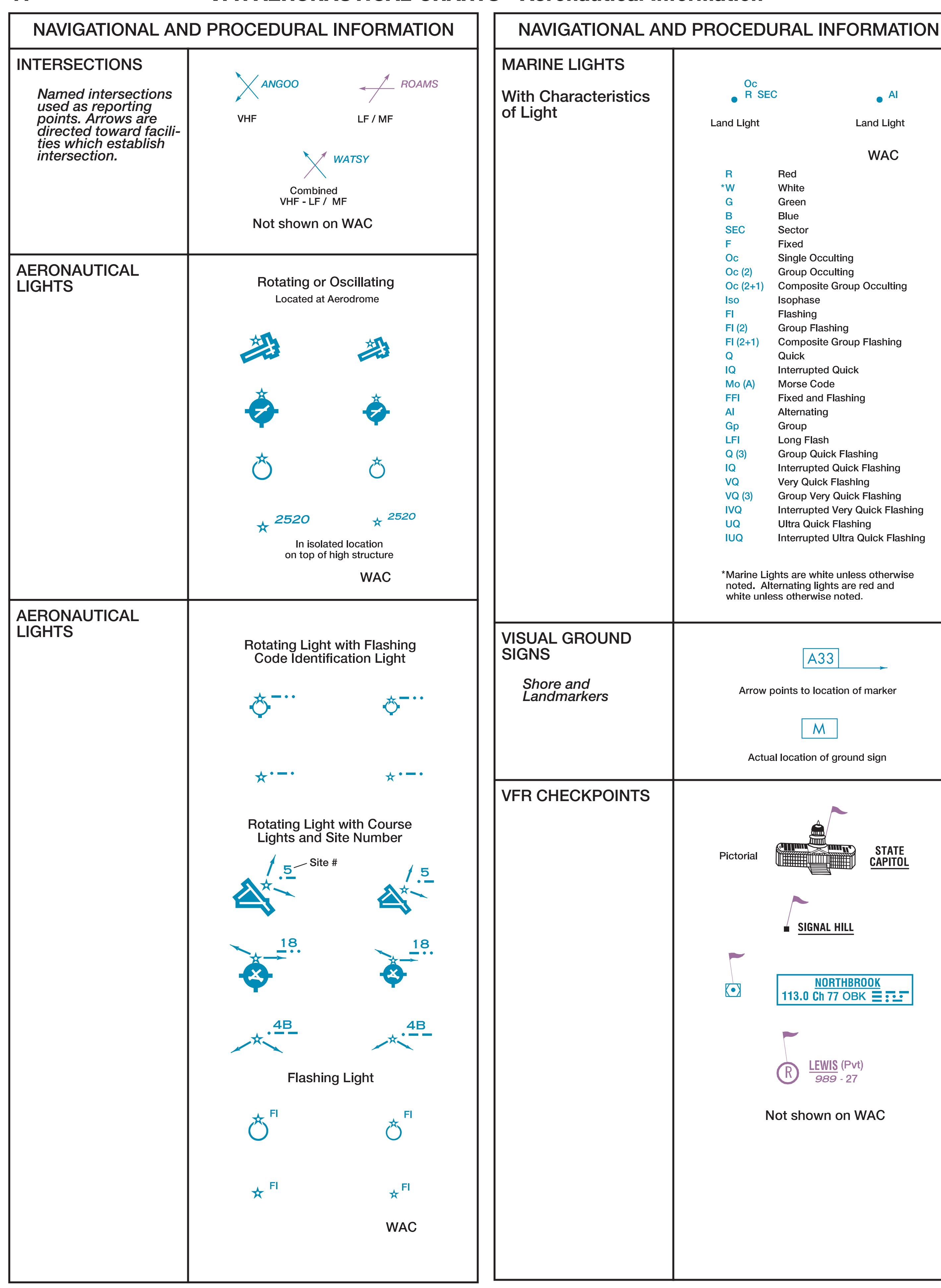

AIRSPACE INFORMATION
AIR DEFENSE IDENTIFICATION ZONE (ADIZ)
Note. Delimiting line not shown when it coincides with International Boundary, projection lines or other linear features.
ALASKA ADIZ
LOW ALTITUDE AIRWAYS VOR and LF / MF (CLASS E AIRSPACE)
Low altitude Federal Airways are indicated by centerline.
Only the controlled airspace effective below 18,000 feet MSL is shown.
V2N
270°
Alternate Airway radial
Total mileage between NAVAIDS on direct Airways.
25
V2
255°
Enroute Airway radial
R40
LF / MF Airway
WAC
MISCELLANEOUS AIR ROUTES
BR 63V
265°
Bahama Route
A 301
Oceanic & ATS Route
AR5
Atlantic Route
GULF RTE 26
Gulf Route
B ROUTE 2
Class G Route
WAC
AIRSPACE INFORMATION
SPECIAL USE AIRSPACE
Only the airspace effective below 18,000 feet MSL are shown.
The type of area shall be spelled out in large areas if space permits.
P-56
OR
R-6401
OR
W-518
PROHIBITED, RESTRICTED OR WARNING AREA
ALERT AREA
A-631
CONCENTRATED STUDENT HELICOPTER TRAINING
ALERT AREA
VANCE 2 MOA
MILITARY OPERATIONS AREA (MOA)
MILITARY TRAINING ROUTES (MTR)
IR292
Not shown on WAC
SPECIAL MILITARY ACTIVITY ROUTES (SMAR)
40
05 AGL
45
05 AGL
Boxed notes (as in text) shown adjacent to route.
SPECIAL MILITARY ACTIVITY
CONTACT MOBILE FSS
ON 123.6
FOR ACTIVITY STATUS
40
05 AGL
Ceiling of SMAR in hundreds of feet MSL
Floor of SMAR in hundreds of feet AGL
Not shown on WAC

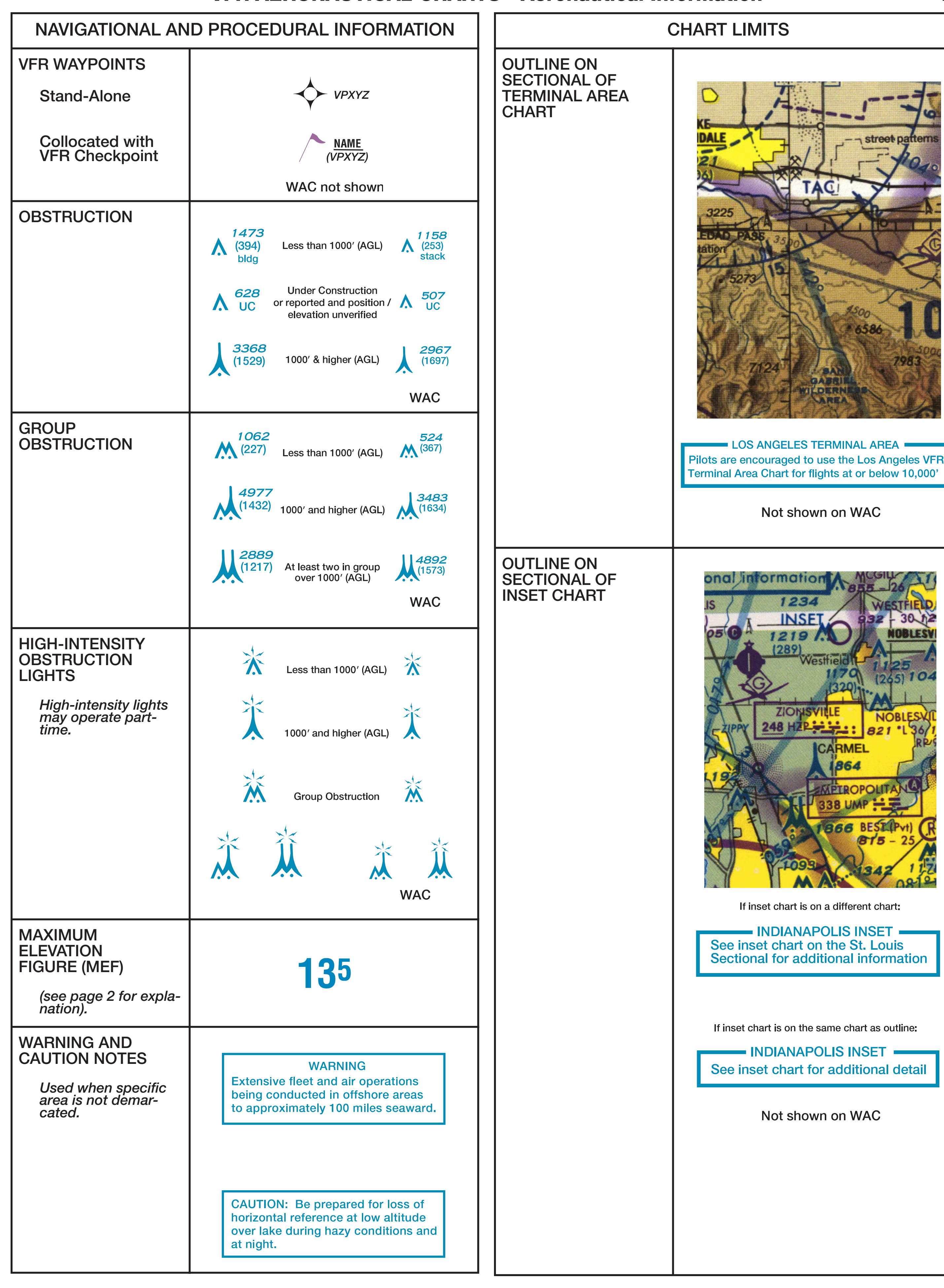


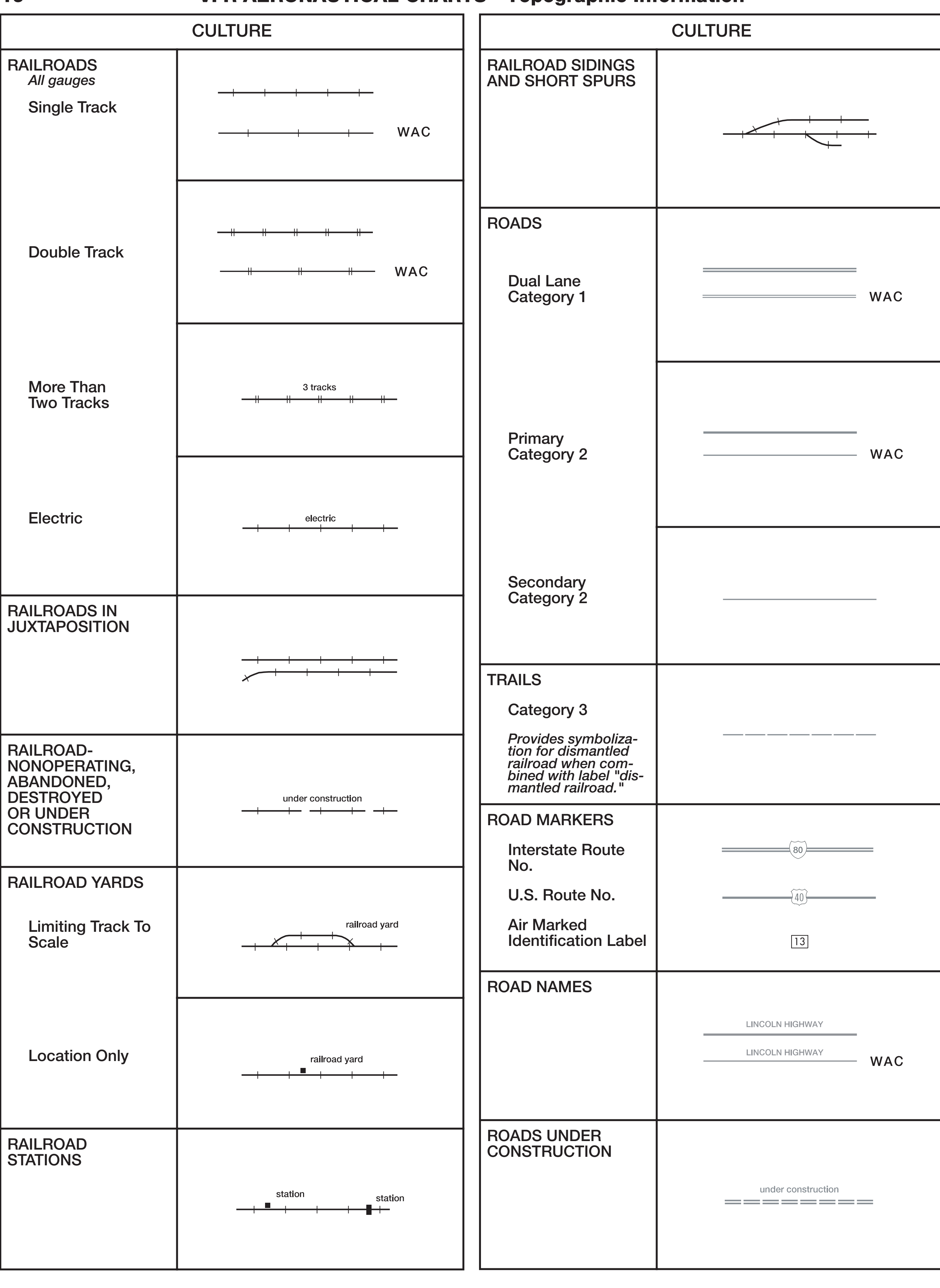
AIRSPACE INFORMATION	
SPECIAL AIR TRAFFIC RULES / AIRPORT PATTERNS (FAR 93) *Appropriate boxed note as required shown adjacent to area.*	SPECIAL NOTICE Pilots are required to obtain an ATC clearance prior to entering this area.
SPACE OPERATIONS AREA (FAR 91.143)	DARKER TINT IS FAR 91.143 AREA Not shown on WAC
MODE C (FAR 91.215) *Appropriate notes as required may be shown.*	MODE C 30 NM
MISCELLANEOUS AIRSPACE AREAS Parachute Jumping Area with Frequency Glider Operating Area Ultralight Activity Hang Glider Activity	122.9 G U H Not shown on WAC
SPECIAL CONSERVATION AREAS National Park, Wildlife Refuge, Primitive and Wilderness Areas, etc.	PAHRANAGAT NATIONAL WILDLIFE REFUGE Not shown on WAC

AIRSPACE INFORMATION	
SPECIAL AIRSPACE AREAS SPECIAL FEDERAL AVIATION REGULATIONS (SFAR) AREAS *Appropriate notes as required may be shown.*	SPECIAL FEDERAL AVIATION REGULATIONS (SFAR) 14 CFR Part 93, Subpart U and SFAR 50.2 - GRAND CANYON NATIONAL PARK SPECIAL FLIGHT RULES AREA. Special regulations apply to all aircraft operations below 18,000 feet MSL.
SFAR AREA RELATING TO NATIONAL SECURITY Example: Washington DC *Appropriate notes as required may be shown.*	COLLEGE PARK (CGS) AWOS-3 121.225 FREEWAY (W00) BOLLING AFB (BOF) OXONN 332 DC WASH EXEC/HYDE (W32) POTOMAC AIRFIELD (VKX) Upper Marlboro WASHINGTON DC METROPOLITAN AREA SPECIAL FLIGHT RULES AREA IN EFFECT (See SFAR 94 description in chart border).
TEMPORARY FLIGHT RESTRICTION (TFR) RELATING TO NATIONAL SECURITY Example: P-40/R-4009 *Appropriate notes as required may be shown.*	Monterey R-400 P-40 R-4009 Thurmont CAUTION P-40 AND R-4009 EXPANDED BY TEMPORARY FLIGHT RESTRICTION. CONTACT AFSS FOR LATEST STATUS AND NOTAMS Not shown on WAC


AIRSPACE INFORMATION
NATIONAL SECURITY AREA
Appropriate notes as required may be shown.
NOTICE
FOR REASONS OF NATIONAL SECURITY PILOTS ARE REQUESTED TO AVOID FLIGHT BELOW 1200′ MSL IN THIS AREA
Not shown on WAC
HIGH ENERGY RADIATION AREAS
Appropriate notes as required may be shown.
HAZARDOUS LASER TRANSMISSIONS SFC to infinity See Airport Facility/Directory
WAC
TERMINAL RADAR SERVICE AREA (TRSA)
Appropriate notes as required may be shown.
PALM SPRINGS TRSA
80 - Ceiling of TRSA in hundreds of feet MSL
40 - Floor of TRSA in hundreds of feet MSL
SEE TWR FREQ TAB
Not shown on WAC
AIRSPACE INFORMATION
IFR ROUTES
Appropriate notes as required may be shown.
Arrival
10,000 - 5000
Departure
4000 - 8000
TAC only
TRANSITION ROUTES
Appropriate notes as required may be shown.
VFR TRANSITION ROUTE ATC CLEARANCE REQUIRED SEE SHOWBOAT GRAPHIC ON SIDE PANEL
Uni-directional
Bi-directional
TAC only
NAVIGATIONAL AND PROCEDURAL INFORMATION
ISOGONIC LINE & VALUE
Isogonic lines and values shall be based on the five year epoch magnetic variation model.
42°E
42°E
WAC
LOCAL MAGNETIC NOTES
Unreliability Notes
Magnetic disturbance of as much as 78° exists at ground level and 10° or more at 3000 feet above ground level in this vicinity.
COMPASS ROSETTE
Shown only in areas void of VOR roses.
Compass rosette will be based on the five year epoch magnetic variation model.
0
30
60
90
120
150
180
210
240
270
300
330


NAVIGATIONAL AND PROCEDURAL INFORMATION
INTERSECTIONS
Named intersections used as reporting points. Arrows are directed toward facilities which establish intersection.
ANGOO
ROAMS
VHF
LF / MF
WATSY
Combined VHF - LF / MF
Not shown on WAC
AERONAUTICAL LIGHTS
Rotating or Oscillating
Located at Aerodrome
2520
2520
In isolated location on top of high structure
WAC
AERONAUTICAL LIGHTS
Rotating Light with Flashing Code Identification Light
Rotating Light with Course Lights and Site Number
5
Site #
5
18
18
4B
4B
Flashing Light
Fl
Fl
Fl
Fl
WAC
NAVIGATIONAL AND PROCEDURAL INFORMATION
MARINE LIGHTS
With Characteristics of Light
Oc
R SEC
Land Light
Al
Land Light
WAC
R Red
*W White
G Green
B Blue
SEC Sector
F Fixed
Oc Single Occulting
Oc (2) Group Occulting
Oc (2+1) Composite Group Occulting
Iso Isophase
Fl Flashing
Fl (2) Group Flashing
Fl (2+1) Composite Group Flashing
Q Quick
IQ Interrupted Quick
Mo (A) Morse Code
FFl Fixed and Flashing
Al Alternating
Gp Group
LFl Long Flash
Q (3) Group Quick Flashing
IQ Interrupted Quick Flashing
VQ Very Quick Flashing
VQ (3) Group Very Quick Flashing
IVQ Interrupted Very Quick Flashing
UQ Ultra Quick Flashing
IUQ Interrupted Ultra Quick Flashing
*Marine Lights are white unless otherwise noted. Alternating lights are red and white unless otherwise noted.
VISUAL GROUND SIGNS
Shore and Landmarkers
A33
Arrow points to location of marker
M
Actual location of ground sign
VFR CHECKPOINTS
Pictorial
STATE CAPITOL
SIGNAL HILL
NORTHBROOK
113.0 Ch 77 OBK
R
LEWIS (Pvt)
989 - 27
Not shown on WAC


NAVIGATIONAL AND PROCEDURAL INFORMATION
VFR WAYPOINTS
Stand-Alone
VPXYZ
Collocated with VFR Checkpoint
NAME
(VPXYZ)
WAC not shown
OBSTRUCTION
1473
(394)
bldg
Less than 1000′ (AGL)
1158
(253)
stack
628
UC
Under Construction or reported and position / elevation unverified
507
UC
3368
(1529)
1000′ & higher (AGL)
2967
(1697)
WAC
GROUP OBSTRUCTION
1062
(227)
Less than 1000′ (AGL)
524
(367)
4977
(1432)
1000′ and higher (AGL)
3483
(1634)
2889
(1217)
At least two in group over 1000′ (AGL)
4892
(1573)
WAC
HIGH-INTENSITY OBSTRUCTION LIGHTS
High-intensity lights may operate part-time.
Less than 1000′ (AGL)
1000′ and higher (AGL)
Group Obstruction
WAC
MAXIMUM ELEVATION FIGURE (MEF)
(see page 2 for explanation).
135
WARNING AND CAUTION NOTES
Used when specific area is not demarcated.
WARNING
Extensive fleet and air operations being conducted in offshore areas to approximately 100 miles seaward.
CAUTION: Be prepared for loss of horizontal reference at low altitude over lake during hazy conditions and at night.
CHART LIMITS
OUTLINE ON SECTIONAL OF TERMINAL AREA CHART
street patterns
TAC
LOS ANGELES TERMINAL AREA
Pilots are encouraged to use the Los Angeles VFR Terminal Area Chart for flights at or below 10,000’
Not shown on WAC
OUTLINE ON SECTIONAL OF INSET CHART
INSET
If inset chart is on a different chart:
INDIANAPOLIS INSET
See inset chart on the St. Louis Sectional for additional information
If inset chart is on the same chart as outline:
INDIANAPOLIS INSET
See inset chart for additional detail
Not shown on WAC


CULTURE
RAILROADS
All gauges
Single Track
WAC
Double Track
WAC
More Than Two Tracks
3 tracks
Electric
electric
RAILROADS IN JUXTAPOSITION
RAILROAD-NONOPERATING, ABANDONED, DESTROYED OR UNDER CONSTRUCTION
under construction
RAILROAD YARDS
Limiting Track To Scale
railroad yard
Location Only
railroad yard
RAILROAD STATIONS
station
station
CULTURE
RAILROAD SIDINGS AND SHORT SPURS
ROADS
Dual Lane Category 1
WAC
Primary Category 2
WAC
Secondary Category 2
TRAILS
Category 3
Provides symbolization for dismantled railroad when combined with label "dismantled railroad."
ROAD MARKERS
Interstate Route No.
80
U.S. Route No.
40
Air Marked Identification Label
13
ROAD NAMES
LINCOLN HIGHWAY
LINCOLN HIGHWAY
WAC
ROADS UNDER CONSTRUCTION
under construction

CULTURE	
BRIDGES AND VIADUCTS	
Railroad	
Road	
OVERPASSES AND UNDERPASSES	
CAUSEWAYS	
TUNNELS-ROAD AND RAILROAD	
POPULATED PLACES OUTLINED	
Large Cities Category 1	
Cities and Large Towns Category 2	
POPULATED PLACES	
Towns and Villages Category 3	WAC

CULTURE	
FERRIES, FERRY SLIPS AND FORDS	ford ferry ford ferry ferry ferry slip
PROMINENT FENCES	
BOUNDARIES	
International	
State and Provincial	
Convention or Mandate Line	RUSSIA UNITED STATES
Date Line	INTERNATIONAL (Monday) DATE LINE (Sunday)

CULTURE	
TIME ZONES	PST +8 (+7DT) = UTC; MST +7 (+6DT) = UTC — Not shown on WAC
MINES AND QUARRIES *Shaft Mines and Quarries*	
POWER TRANSMISSION & TELECOMMUNICATION LINES	WAC
PIPELINES	pipeline
Underground	underground pipeline
DAMS	
DAM CARRYING ROAD	
PASSABLE LOCKS	locks

CULTURE	
SMALL LOCKS	
WEIRS AND JETTIES	jetties
SEAWALLS	seawall
BREAKWATERS	breakwater; breakwater
PIERS, WHARFS, QUAYS, ETC.	piers; piers
MISCELLANEOUS CULTURAL FEATURES	stadium; fort; cemetery
OUTDOOR THEATER	
WELLS Other Than Water	oil

CULTURE	
RACE TRACKS	
LOOKOUT TOWERS Air marked identification	P-17 (Site Number) *618* (Elevation Base of Tower)
LANDMARK AREAS	dark area
TANKS	water oil gas
COAST GUARD STATION	CG
AERIAL CABLEWAYS, CONVEYORS, ETC.	aerial cableway aerial cableway WAC

HYDROGRAPHY	
OPEN WATER	
INLAND WATER	

HYDROGRAPHY	
SHORELINES Definite	
Fluctuating	
Unsurveyed *Indefinite*	
Man-made	
LAKES *Label as required* Perennial *When too numerous to show individual lakes, show representative pattern and descriptive note.*	*numerous small lakes* *756* *618*
Non-Perennial *(dry, intermittent, etc.) Illustration includes small perennial lake*	
RESERVOIRS Natural Shorelines	
Man-made Shorelines *Label when necessary for clarity*	*reservoir*
Too small to show to scale	*reservoir*
Under Construction	*under construction*

HYDROGRAPHY	
STREAMS	
Perennial	
Non-Perennial	
Fanned Out *Alluvial fan*	
Braided	
Disappearing	
Seasonally Fluctuating *with undefined limits*	
with maximum bank limits, prominent and constant	
Sand Deposits In and Along Riverbeds	

HYDROGRAPHY	
WET SAND AREAS *Within and adjacent to desert areas*	
AQUEDUCTS	aqueduct
Abandoned or Under Construction	abandoned aqueduct
Underground	underground aqueduct
Suspended or Elevated	
Tunnels	
Kanats *Underground aqueduct with air vents*	underground aqueduct

HYDROGRAPHY	
FLUMES, PENSTOCKS AND SIMILAR FEATURES	flume
Elevated	flume
Underground	underground flume
FALLS Double-Line	falls
Single-Line	falls
RAPIDS Double-Line	rapids
Single-Line	rapids
CANALS	ERIE

HYDROGRAPHY	
To Scale	
Abandoned or Under Construction	abandoned
Abandoned to Scale	abandoned
SMALL CANALS AND DRAINAGE / IRRIGATION DITCHES Perennial	
Non-Perennial	
Abandoned or Ancient	
Numerous *Representative pattern and/or descriptive note.*	
Numerous	numerous canals and ditches

HYDROGRAPHY	
SALT EVAPORATORS AND SALT PANS MAN EXPLOITED	salt pans
SWAMPS, MARSHES AND BOGS	
HUMMOCKS AND RIDGES	
MANGROVE AND NIPA	mangrove
PEAT BOGS	peat bog
TUNDRA	tundra
CRANBERRY BOGS	cranberry bog
RICE PADDIES *Extensive areas indicated by label only.*	

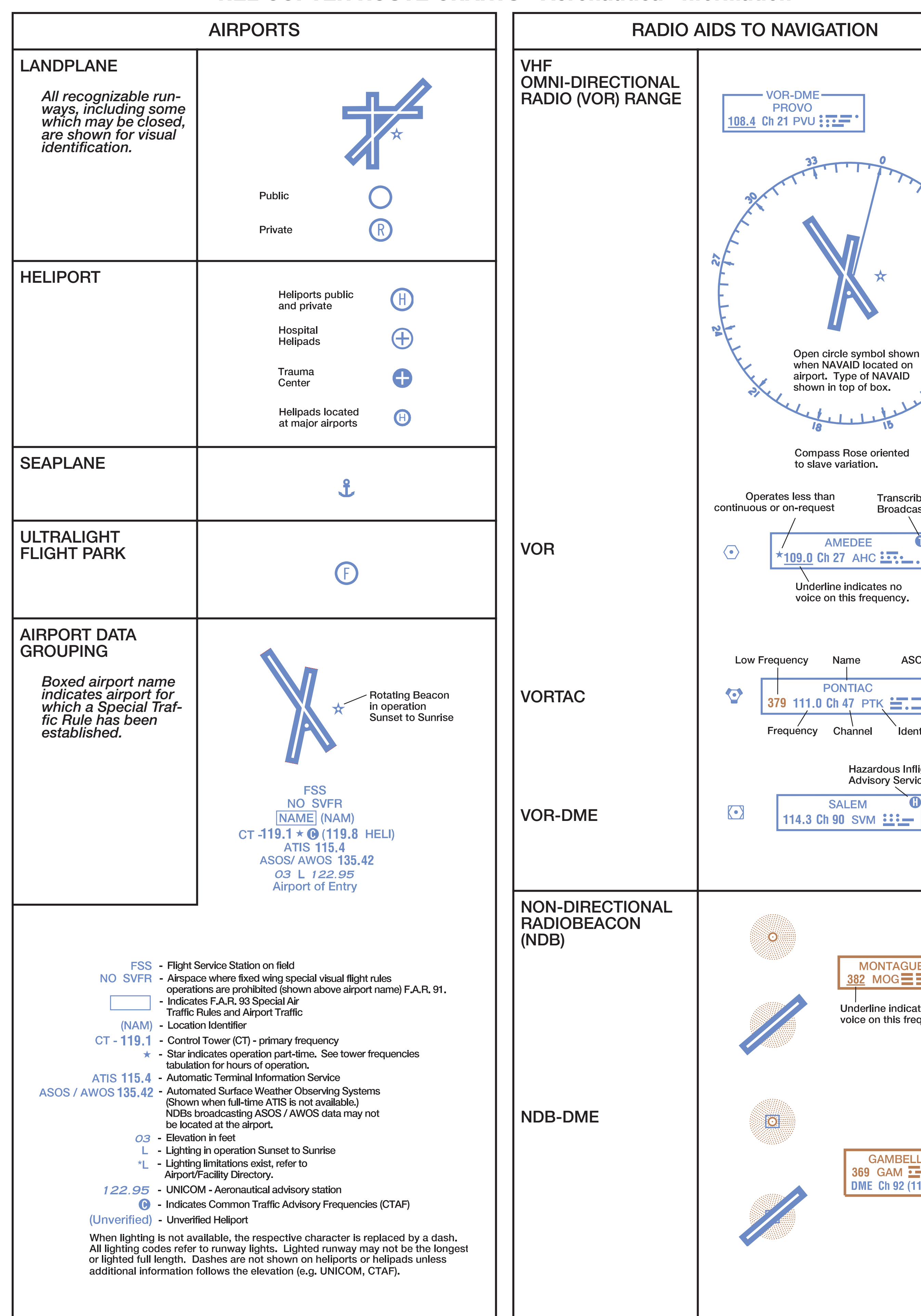
HYDROGRAPHY	
LAND SUBJECT TO INUNDATION	
SPRINGS, WELLS AND WATERHOLES	
GLACIERS	
GLACIAL MORAINES	
ICE CLIFFS	
SNOWFIELDS, ICE FIELDS AND ICE CAPS	9000 8000 7000
ICE PEAKS	
FORESHORE FLATS *Tidal flats exposed at low tide.*	

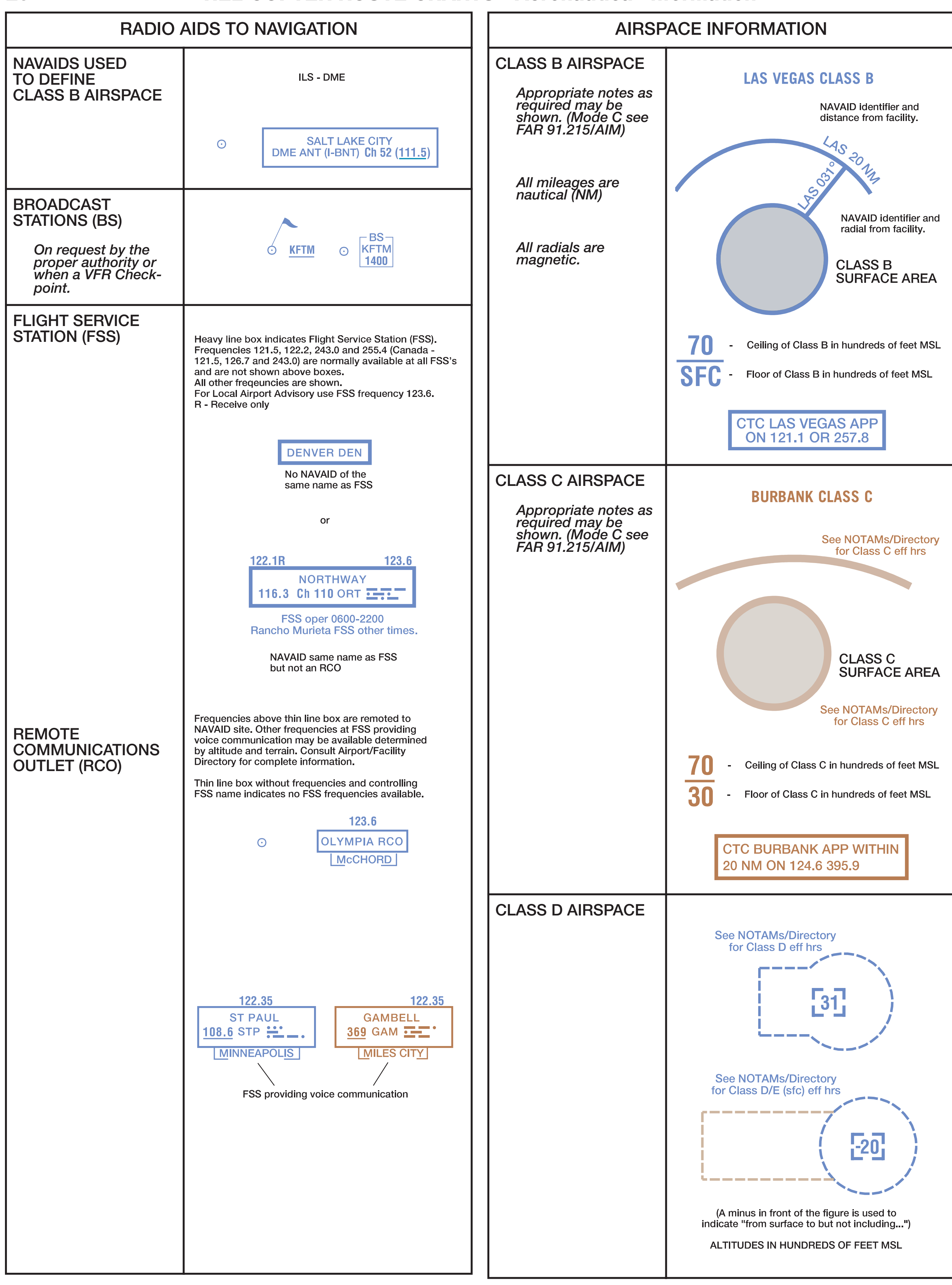
HYDROGRAPHY	
ROCKS-ISOLATED Bare or Awash	
WRECKS Exposed	
REEFS-ROCKY OR CORAL	
MISCELLANEOUS UNDERWATER FEATURES NOT OTHERWISE SYMBOLIZED	
FISH PONDS AND HATCHERIES	
ICE Permanent Polar Ice Pack Ice	

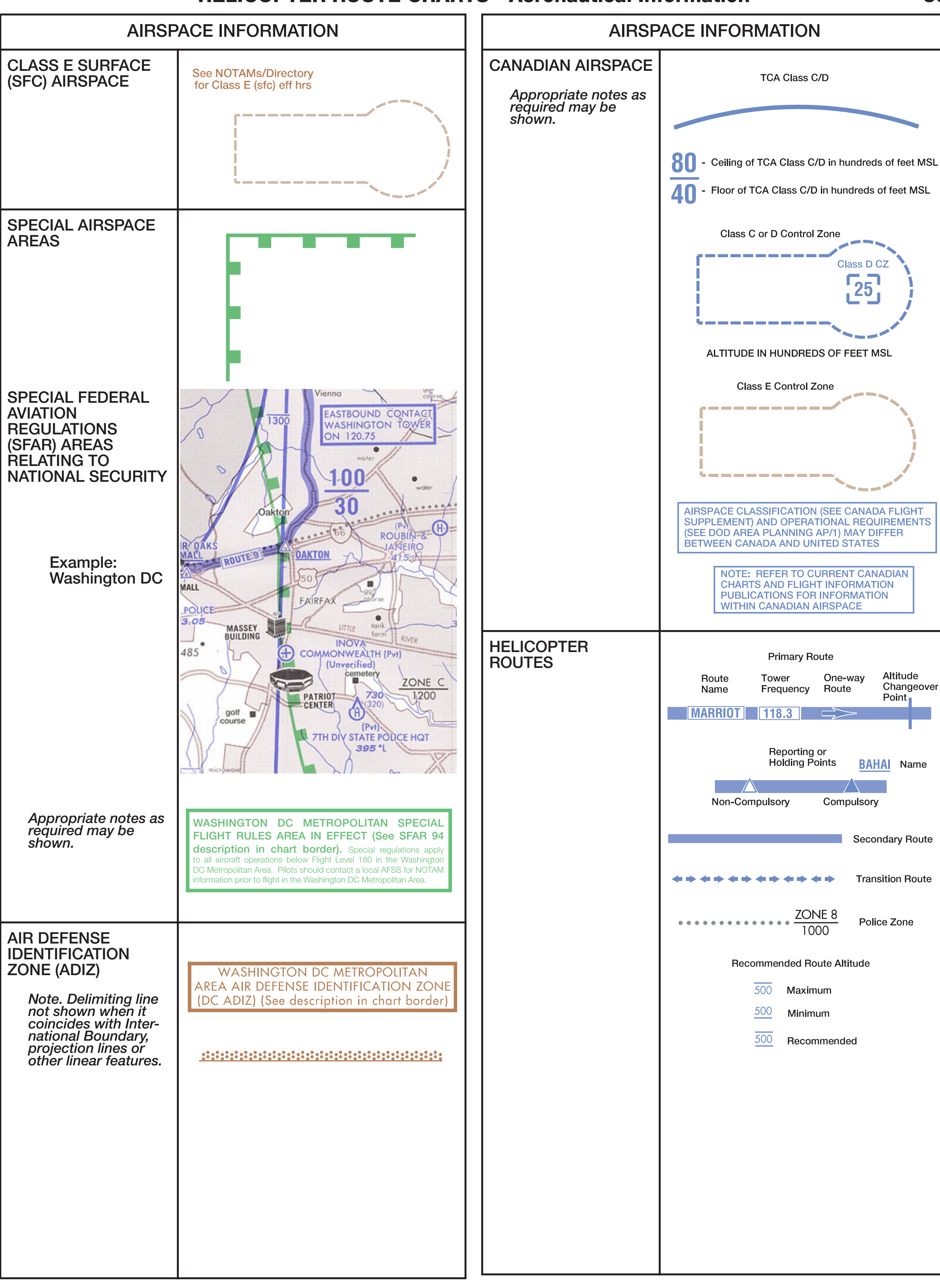
RELIEF	
CONTOURS Basic	
Approximate	
Intermediate	
Auxiliary	
Depression *Illustration includes mound within depression*	
Values	

RELIEF	
SPOT ELEVATIONS Position Accurate	2216
Position Accurate, Elevation Approximate	2260
Approximate location	2119
Critical	6973 6973 WAC
Highest on Chart	12770
MOUNTAIN PASS	12632
HACHURING	
UNSURVEYED AREAS *Label appropriately as required*	UNSURVEYED
UNCONTOURED AREAS *Label appropriately as required*	RELIEF DATA INCOMPLETE
DISTORTED SURFACE AREAS	lava
LAVA FLOWS	

RELIEF	
SAND OR GRAVEL AREAS	
SAND RIDGES To Scale	
SAND DUNES To Scale	
SHADED RELIEF	
ROCK STRATA OUTCROP	rock strata
QUARRIES TO SCALE	quarry
STRIP MINES, MINE DUMPS AND TAILINGS To Scale	strip mine mine dump
CRATERS	crater crater
ESCARPMENTS, BLUFFS, CLIFFS, DEPRESSIONS, ETC.	
LEVEES AND ESKERS	levee


AIRPORTS
LANDPLANE
All recognizable runways, including some which may be closed, are shown for visual identification.
Public
Private
HELIPORT
Heliports public and private
Hospital Helipads
Trauma Center
Helipads located at major airports
SEAPLANE
ULTRALIGHT FLIGHT PARK
AIRPORT DATA GROUPING
Boxed airport name indicates airport for which a Special Traffic Rule has been established.
Rotating Beacon in operation Sunset to Sunrise
FSS
NO SVFR
NAME (NAM)
CT -119.1 ★ (C) (119.8 HELI)
ATIS 115.4
ASOS/ AWOS 135.42
03 L 122.95
Airport of Entry
FSS - Flight Service Station on field
NO SVFR - Airspace where fixed wing special visual flight rules operations are prohibited (shown above airport name) F.A.R. 91.
- Indicates F.A.R. 93 Special Air Traffic Rules and Airport Traffic
(NAM) - Location Identifier
CT - 119.1 - Control Tower (CT) - primary frequency
★ - Star indicates operation part-time. See tower frequencies tabulation for hours of operation.
ATIS 115.4 - Automatic Terminal Information Service
ASOS / AWOS 135.42 - Automated Surface Weather Observing Systems (Shown when full-time ATIS is not available.) NDBs broadcasting ASOS / AWOS data may not be located at the airport.
03 - Elevation in feet
L - Lighting in operation Sunset to Sunrise
*L - Lighting limitations exist, refer to Airport/Facility Directory.
122.95 - UNICOM - Aeronautical advisory station
(C) - Indicates Common Traffic Advisory Frequencies (CTAF)
(Unverified) - Unverified Heliport
When lighting is not available, the respective character is replaced by a dash. All lighting codes refer to runway lights. Lighted runway may not be the longest or lighted full length. Dashes are not shown on heliports or helipads unless additional information follows the elevation (e.g. UNICOM, CTAF).
RADIO AIDS TO NAVIGATION
VHF OMNI-DIRECTIONAL RADIO (VOR) RANGE
VOR-DME
PROVO
108.4 Ch 21 PVU
Open circle symbol shown when NAVAID located on airport. Type of NAVAID shown in top of box.
Compass Rose oriented to slave variation.
VOR
Operates less than continuous or on-request
Transcribed Weather Broadcast (TWEB)
AMEDEE
★109.0 Ch 27 AHC
Underline indicates no voice on this frequency.
VORTAC
Low Frequency
Name
ASOS/AWOS
PONTIAC
379 111.0 Ch 47 PTK
Morse Code
Frequency
Channel
Identifier
VOR-DME
Hazardous Inflight Weather Advisory Service (HIWAS)
SALEM
114.3 Ch 90 SVM
NON-DIRECTIONAL RADIOBEACON (NDB)
MONTAGUE
382 MOG
Underline indicates no voice on this frequency.
NDB-DME
GAMBELL
369 GAM
DME Ch 92 (114.5)


RADIO AIDS TO NAVIGATION
NAVAIDS USED TO DEFINE CLASS B AIRSPACE
ILS - DME
SALT LAKE CITY
DME ANT (I-BNT) Ch 52 (111.5)
BROADCAST STATIONS (BS)
On request by the proper authority or when a VFR Check-point.
KFTM
BS
KFTM
1400
FLIGHT SERVICE STATION (FSS)
Heavy line box indicates Flight Service Station (FSS).
Frequencies 121.5, 122.2, 243.0 and 255.4 (Canada - 121.5, 126.7 and 243.0) are normally available at all FSS's and are not shown above boxes.
All other freqeuncies are shown.
For Local Airport Advisory use FSS frequency 123.6.
R - Receive only
DENVER DEN
No NAVAID of the same name as FSS
or
122.1R
123.6
NORTHWAY
116.3 Ch 110 ORT
FSS oper 0600-2200
Rancho Murieta FSS other times.
NAVAID same name as FSS but not an RCO
REMOTE COMMUNICATIONS OUTLET (RCO)
Frequencies above thin line box are remoted to NAVAID site. Other frequencies at FSS providing voice communication may be available determined by altitude and terrain. Consult Airport/Facility Directory for complete information.
Thin line box without frequencies and controlling FSS name indicates no FSS frequencies available.
123.6
OLYMPIA RCO
McCHORD
122.35
ST PAUL
108.6 STP
MINNEAPOLIS
122.35
GAMBELL
369 GAM
MILES CITY
FSS providing voice communication
AIRSPACE INFORMATION
CLASS B AIRSPACE
Appropriate notes as required may be shown. (Mode C see FAR 91.215/AIM)
All mileages are nautical (NM)
All radials are magnetic.
LAS VEGAS CLASS B
NAVAID identifier and distance from facility.
LAS 20 NM
LAS 031°
NAVAID identifier and radial from facility.
CLASS B SURFACE AREA
70 - Ceiling of Class B in hundreds of feet MSL
SFC - Floor of Class B in hundreds of feet MSL
CTC LAS VEGAS APP
ON 121.1 OR 257.8
CLASS C AIRSPACE
Appropriate notes as required may be shown. (Mode C see FAR 91.215/AIM)
BURBANK CLASS C
See NOTAMs/Directory for Class C eff hrs
CLASS C SURFACE AREA
See NOTAMs/Directory for Class C eff hrs
70 - Ceiling of Class C in hundreds of feet MSL
30 - Floor of Class C in hundreds of feet MSL
CTC BURBANK APP WITHIN
20 NM ON 124.6 395.9
CLASS D AIRSPACE
See NOTAMs/Directory for Class D eff hrs
31
See NOTAMs/Directory for Class D/E (sfc) eff hrs
-20
(A minus in front of the figure is used to indicate "from surface to but not including...")
ALTITUDES IN HUNDREDS OF FEET MSL


AIRSPACE INFORMATION
CLASS E SURFACE (SFC) AIRSPACE
See NOTAMs/Directory for Class E (sfc) eff hrs
SPECIAL AIRSPACE AREAS
SPECIAL FEDERAL AVIATION REGULATIONS (SFAR) AREAS RELATING TO NATIONAL SECURITY
Example: Washington DC
Vienna
1300
EASTBOUND CONTACT WASHINGTON TOWER ON 120.75
100
30
Oakton
OAKTON
ROUTE 9
ROUBIN & JANEIRO
FAIRFAX
POLICE
MASSEY BUILDING
INOVA COMMONWEALTH (Pvt) (Unverified)
ZONE C
1200
PATRIOT CENTER
7TH DIV STATE POLICE HQT
Appropriate notes as required may be shown.
WASHINGTON DC METROPOLITAN SPECIAL FLIGHT RULES AREA IN EFFECT (See SFAR 94 description in chart border). Special regulations apply to all aircraft operations below Flight Level 180 in the Washington DC Metropolitan Area. Pilots should contact a local AFSS for NOTAM information prior to flight in the Washington DC Metropolitan Area.
AIR DEFENSE IDENTIFICATION ZONE (ADIZ)
Note. Delimiting line not shown when it coincides with International Boundary, projection lines or other linear features.
WASHINGTON DC METROPOLITAN AREA AIR DEFENSE IDENTIFICATION ZONE (DC ADIZ) (See description in chart border)
AIRSPACE INFORMATION
CANADIAN AIRSPACE
Appropriate notes as required may be shown.
TCA Class C/D
80 - Ceiling of TCA Class C/D in hundreds of feet MSL
40 - Floor of TCA Class C/D in hundreds of feet MSL
Class C or D Control Zone
Class D CZ
25
ALTITUDE IN HUNDREDS OF FEET MSL
Class E Control Zone
AIRSPACE CLASSIFICATION (SEE CANADA FLIGHT SUPPLEMENT) AND OPERATIONAL REQUIREMENTS (SEE DOD AREA PLANNING AP/1) MAY DIFFER BETWEEN CANADA AND UNITED STATES
NOTE: REFER TO CURRENT CANADIAN CHARTS AND FLIGHT INFORMATION PUBLICATIONS FOR INFORMATION WITHIN CANADIAN AIRSPACE
HELICOPTER ROUTES
Primary Route
Route Name
Tower Frequency
One-way Route
Altitude Changeover Point
MARRIOT
118.3
Reporting or Holding Points
BAHAI
Name
Non-Compulsory
Compulsory
Secondary Route
Transition Route
ZONE 8
1000
Police Zone
Recommended Route Altitude
500 Maximum
500 Minimum
500 Recommended

AIRSPACE INFORMATION

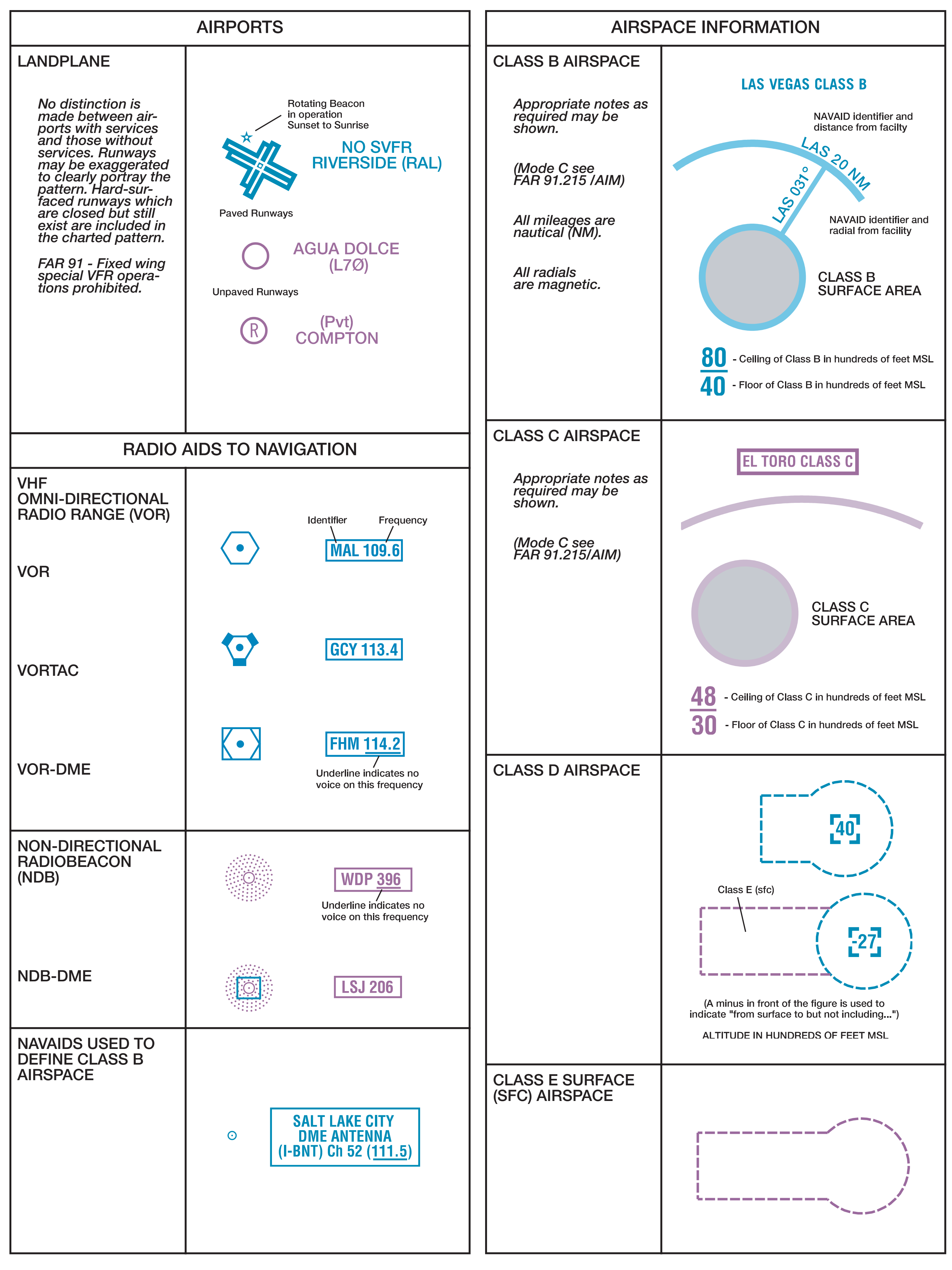
SPECIAL USE AIRSPACE *Only the airspace effective below 18,000 feet MSL is shown.* *The type of area shall be spelled out in large areas if space permits.*	P-56 OR R-6401 / W-518 OR A-631 PROHIBITED, RESTRICTED, WARNING OR ALERT AREA FALCON 1 MOA MILITARY OPERATIONS AREA (MOA)
MILITARY TRAINING ROUTES (MTR)	VR269
SPECIAL AIR TRAFFIC RULES / AIRPORT TRAFFIC AREAS (FAR PART 93) *Appropriate boxed notes as required shown adjacent to area.*	SPECIAL NOTICE Pilots are required to obtain an ATC clearance prior to entering this area.
MODE C (FAR 91.215) *Appropriate notes as required may be shown.*	MODE C 30 NM
MISCELLANEOUS AIRSPACE AREAS Parachute Jumping Area with Frequency Glider Operating Area Ultralight Activity Hang Glider Activity	122.9 G U H
SPECIAL CONSERVATION AREAS National Park, Wildlife Refuge, Primitive and Wilderness Areas, etc.	HAVASU LAKE NATIONAL WILDLIFE REFUGE
TERMINAL RADAR SERVICE AREA (TRSA) *Appropriate notes as required may be shown.*	PALM SPRINGS TRSA SEE TWR FREQ TAB 80 - Ceiling of TRSA in hundreds of feet MSL 40 - Floor of TRSA in hundreds of feet MSL

NAVIGATIONAL AND PROCEDURAL INFORMATION

VFR CHECKPOINTS	Pictorial: STATE CAPITOL STACKS 122.2 FRANCIS PEAK RCO CEDAR CITY (Pvt) LEWIS 420
VFR WAYPOINTS Stand-Alone Collocated with VFR Checkpoint	VPXYZ NAME (VPXYZ)
OBSTRUCTIONS	bldg 1000′ and higher AGL 300′ and higher AGL or — Group Obstruction or — Obstruction with high-intensity lights. 2049 — Elevation of the top above mean sea level (1149) — Height above ground UC — Under Construction or reported and position / elevation unverified
MAXIMUM ELEVATION FIGURE (MEF) *(see page 2 for explanation).*	124
NAVIGATION DATA	N38°56.32′ W76°36.91′ POWER PLANT N32°27.12′ W70°15.73′ ATL 25 NM ATL 033° ATL 033/25 NM N33°59.18′ W84°10.62′

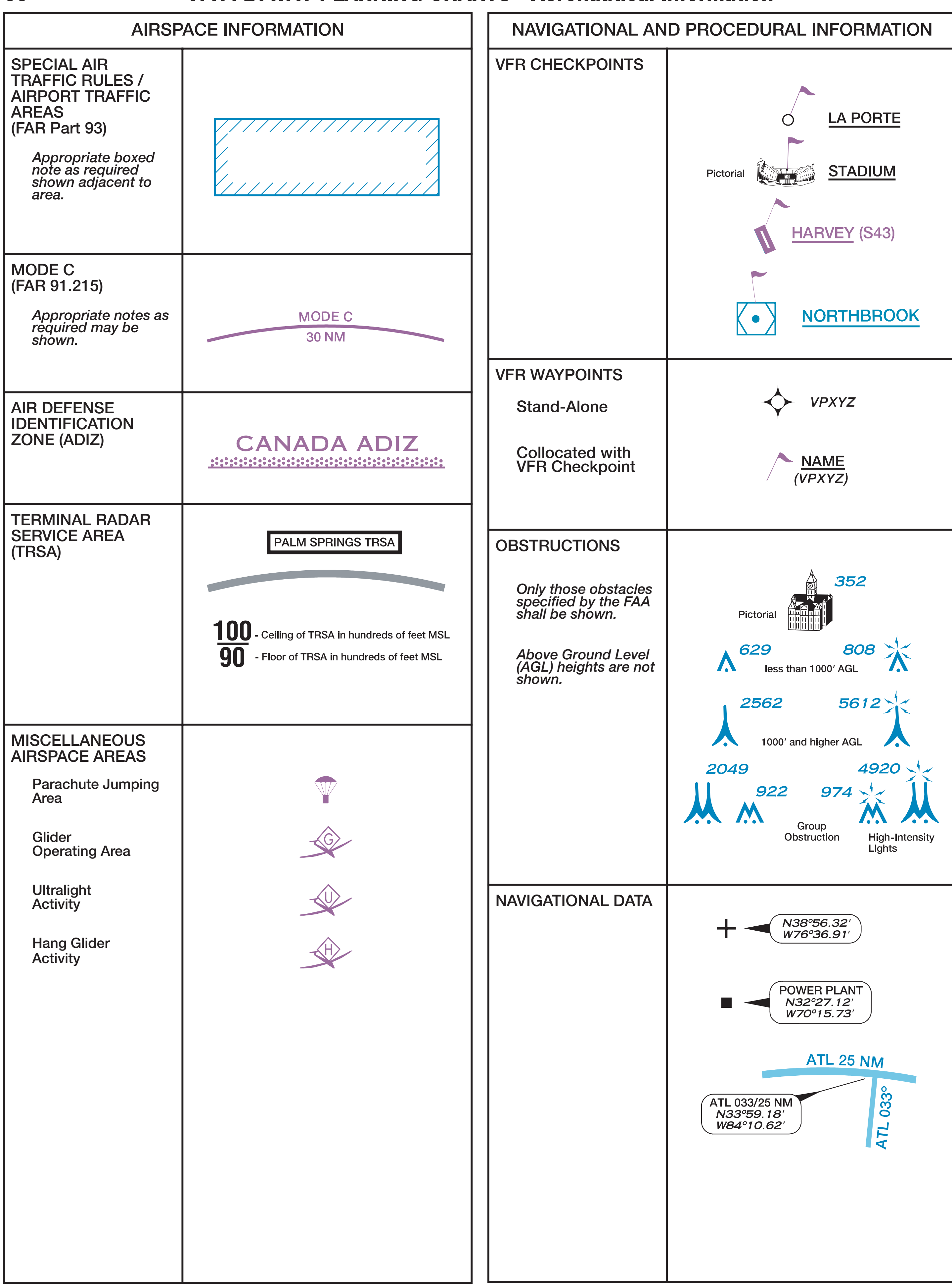
NAVIGATIONAL AND PROCEDURAL INFORMATION	
WARNING AND CAUTION NOTES	WARNING Extensive fleet and air operations being conducted in offshore areas to approximately 100 miles seaward. CAUTION: Be prepared for loss of horizontal reference at low altitude over lake during hazy conditions and at night.
LOCAL MAGNETIC NOTES Unreliability Notes	Magnetic disturbance of as much as 78° exists at ground level and 10° or more at 3000 feet above ground level in this vicinity.
CULTURE	
RAILROADS Single Track Double Track	
ROADS Dual Lane Primary	HOLLYWOOD BOULEVARD 495 95 25
BRIDGES	Railroad Road
POPULATED PLACES Built-up Areas	
BOUNDARIES International State and Provincial	

CULTURE	
POWER TRANSMISSION LINES	
PROMINENT PICTORIALS	TEMPLE
LANDMARKS	Landmark Feature-stadium, factory, school, etc. Mines and Quarries Race Track Outdoor Theater Tank-water, oil or gas
HYDROGRAPHY	
SHORELINES	
MAJOR LAKES AND RIVERS	
RESERVOIRS	Dam
RELIEF	
SPOT ELEVATIONS Position Accurate	405


AIRPORTS
LANDPLANE
No distinction is made between airports with services and those without services. Runways may be exaggerated to clearly portray the pattern. Hard-surfaced runways which are closed but still exist are included in the charted pattern.
FAR 91 - Fixed wing special VFR operations prohibited.
Rotating Beacon in operation Sunset to Sunrise
NO SVFR
RIVERSIDE (RAL)
Paved Runways
AGUA DOLCE
(L7Ø)
Unpaved Runways
(Pvt)
COMPTON
RADIO AIDS TO NAVIGATION
VHF OMNI-DIRECTIONAL RADIO RANGE (VOR)
VOR
Identifier
Frequency
MAL 109.6
VORTAC
GCY 113.4
VOR-DME
FHM 114.2
Underline indicates no voice on this frequency
NON-DIRECTIONAL RADIOBEACON (NDB)
WDP 396
Underline indicates no voice on this frequency
NDB-DME
LSJ 206
NAVAIDS USED TO DEFINE CLASS B AIRSPACE
SALT LAKE CITY
DME ANTENNA
(I-BNT) Ch 52 (111.5)
AIRSPACE INFORMATION
CLASS B AIRSPACE
Appropriate notes as required may be shown.
(Mode C see FAR 91.215 /AIM)
All mileages are nautical (NM).
All radials are magnetic.
LAS VEGAS CLASS B
NAVAID identifier and distance from facilty
LAS 20 NM
LAS 031°
NAVAID identifier and radial from facility
CLASS B SURFACE AREA
80 - Ceiling of Class B in hundreds of feet MSL
40 - Floor of Class B in hundreds of feet MSL
CLASS C AIRSPACE
Appropriate notes as required may be shown.
(Mode C see FAR 91.215/AIM)
EL TORO CLASS C
CLASS C SURFACE AREA
48 - Ceiling of Class C in hundreds of feet MSL
30 - Floor of Class C in hundreds of feet MSL
CLASS D AIRSPACE
40
Class E (sfc)
-27
(A minus in front of the figure is used to indicate "from surface to but not including...")
ALTITUDE IN HUNDREDS OF FEET MSL
CLASS E SURFACE (SFC) AIRSPACE

AIRSPACE INFORMATION	
SPECIAL AIRSPACE AREAS	
SPECIAL FEDERAL AVIATION REGULATIONS (SFAR) AREAS RELATING TO NATIONAL SECURITY Example: Washington DC	
Appropriate notes as required may be shown.	**WASHINGTON DC METROPOLITAN AREA SPECIAL FLIGHT RULES AREA IN EFFECT (See SFAR 94 description in chart border).** Special regulations apply to all aircraft operations below Flight Level 180 in the Washington DC Metropolitan Area. Pilots should contact a local AFSS for NOTAM information prior to flight in the Washington DC Metropolitan Area.
TEMPORARY FLIGHT RESTRICTION (TFR) RELATING TO NATIONAL SECURITY Example: P-40/R-4009	P-40 R-4009
Appropriate notes as required may be shown.	CAUTION P-40 AND R-4009 EXPANDED BY TEMPORARY FLIGHT RESTRICTION. CONTACT AFSS FOR LATEST STATUS AND NOTAMS.

AIRSPACE INFORMATION	
SUGGESTED VFR FLYWAY AND ALTITUDE	Direction; Mileage 35; 195° 2600 | 6700 015°; Radial/Bearing from or to NAVAID; Altitude; Altitude Change
IFR ROUTES *Appropriate notes as required may be shown.* Arrival Departure	10,000 - 5000 4000 - 8000
TRANSITION ROUTES *Appropriate notes as required may be shown.* Uni-directional Bi-directional	VFR TRANSITION ROUTE ATC CLEARANCE REQUIRED SEE SHOWBOAT GRAPHIC ON SIDE PANEL
SPECIAL USE AIRSPACE *Only the airspace effective below 18,000 feet MSL is shown.*	P-56 OR R-6401 W-518 OR A-631 PROHIBITED, RESTRICTED ALERT OR WARNING AREA FALCON 1 MOA MILITARY OPERATIONS AREA (MOA)
MILITARY TRAINING ROUTES (MTR)	IR21



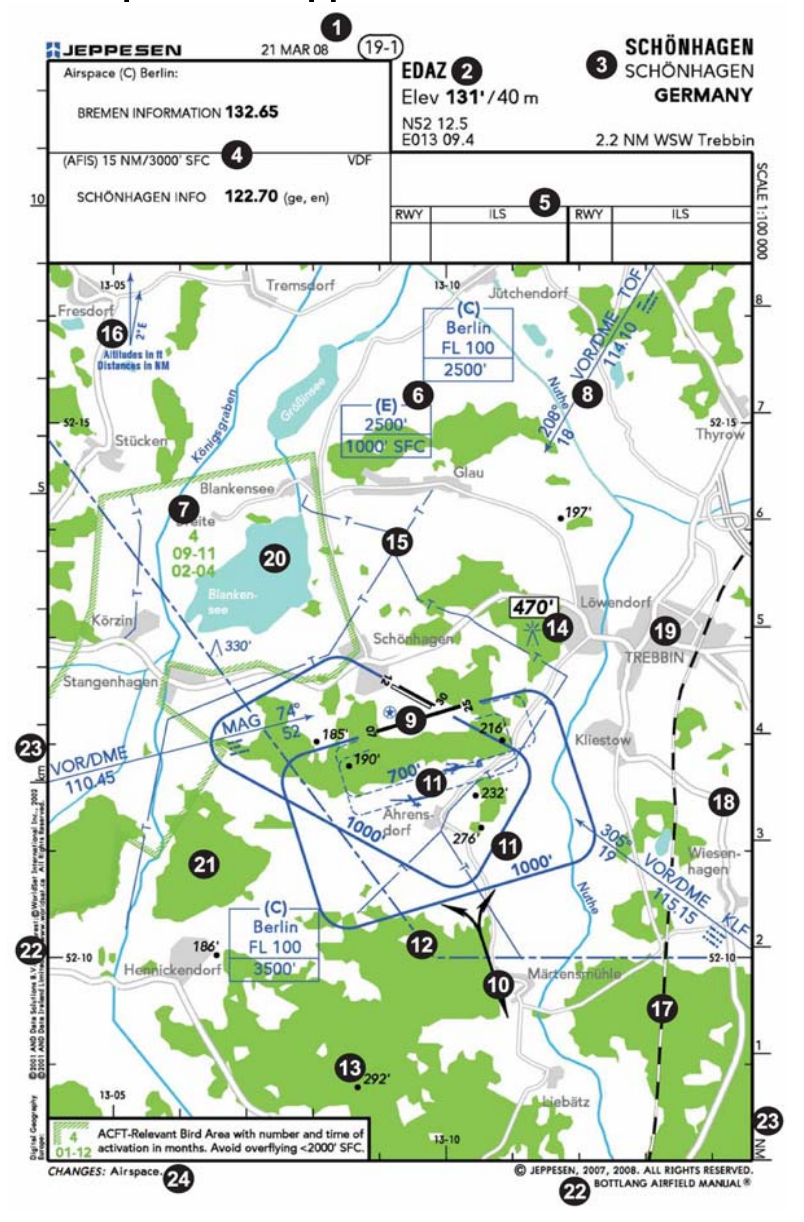
AIRSPACE INFORMATION
SPECIAL AIR TRAFFIC RULES / AIRPORT TRAFFIC AREAS (FAR Part 93)
Appropriate boxed note as required shown adjacent to area.
MODE C (FAR 91.215)
Appropriate notes as required may be shown.
MODE C
30 NM
AIR DEFENSE IDENTIFICATION ZONE (ADIZ)
CANADA ADIZ
TERMINAL RADAR SERVICE AREA (TRSA)
PALM SPRINGS TRSA
100 - Ceiling of TRSA in hundreds of feet MSL
90 - Floor of TRSA in hundreds of feet MSL
MISCELLANEOUS AIRSPACE AREAS
Parachute Jumping Area
Glider Operating Area
G
Ultralight Activity
U
Hang Glider Activity
H
NAVIGATIONAL AND PROCEDURAL INFORMATION
VFR CHECKPOINTS
LA PORTE
Pictorial
STADIUM
HARVEY (S43)
NORTHBROOK
VFR WAYPOINTS
Stand-Alone
VPXYZ
Collocated with VFR Checkpoint
NAME
(VPXYZ)
OBSTRUCTIONS
Only those obstacles specified by the FAA shall be shown.
Above Ground Level (AGL) heights are not shown.
Pictorial
352
629
808
less than 1000′ AGL
2562
5612
1000′ and higher AGL
2049
4920
922
974
Group Obstruction
High-Intensity Lights
NAVIGATIONAL DATA
N38°56.32′
W76°36.91′
POWER PLANT
N32°27.12′
W70°15.73′
ATL 25 NM
ATL 033/25 NM
N33°59.18′
W84°10.62′
ATL 033°

CULTURE	
RAILROADS Single and Multiple Tracks	
ROADS Dual Lane Primary	HARBOR FREEWAY 110 40
POPULATED PLACES Built-up Areas Towns	BREMERTON LAWRENCEVILLE
BOUNDARIES International	
POWER TRANSMISSION LINES	
PROMINENT PICTORIALS	TEMPLE
LANDMARKS	POWER PLANT
HYDROGRAPHY	
SHORELINES	
MAJOR LAKES AND RIVERS	Bridge
RESERVOIRS	Dam

RELIEF	
Spot Elevations Position Accurate Mountain Peaks	6504



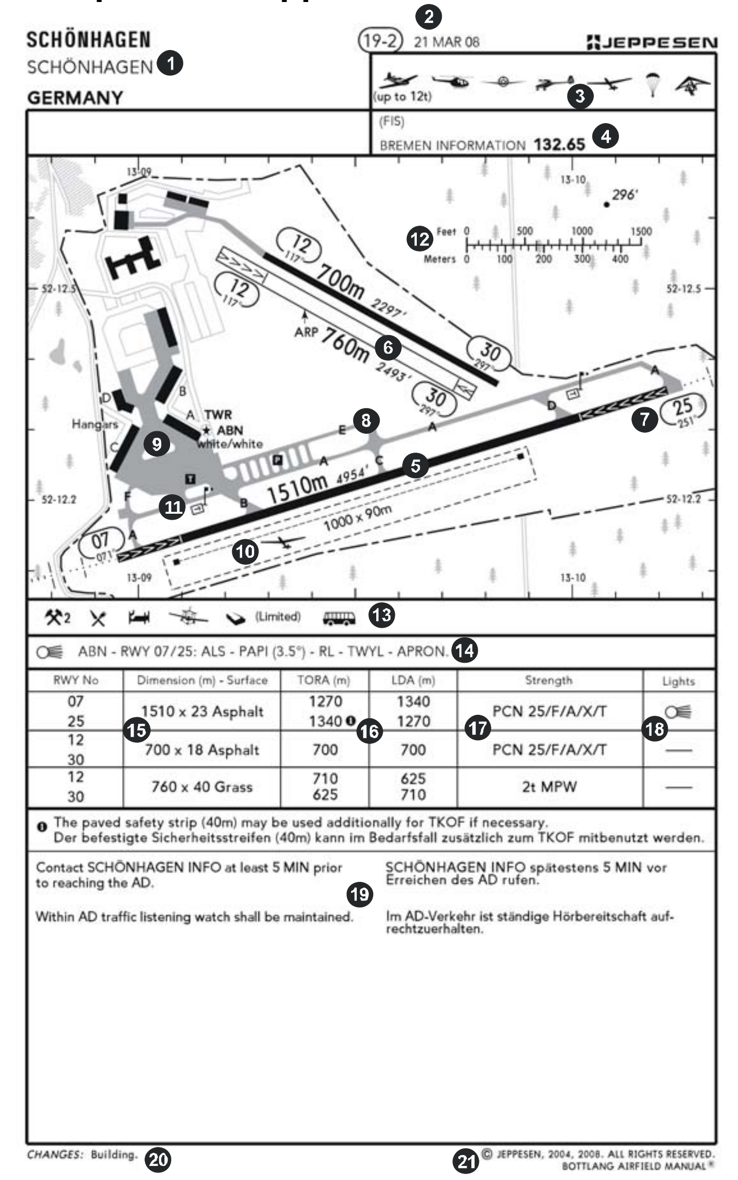
Sample from Jeppesen VFR MANUAL



	English	Deutsch
1	Revision date and Chart Index	Berichtigungsdatum und Karten-Ordnungsnummer
2	ICAO Location Indicator, Apt ELEV in feet **and** Meters, Apt coordinates	Flugplatzkennung, Flugplatzhöhe in Fuss **und** Meter, Koordinaten
3	Location-/Airportname, Country	Orts-/Flugplatzname, Land
4	Communications	Flugfunk
5	ILS information (if available)	ILS Informationen (wenn vorhanden)
6	Controlled Airspace with vertical limits	Kontrollierter Luftraum mit Ober- und Untergrenze
7	Aircraft-Relevant Bird Area	Luftfahrtrelevante Vogelvorkommen
8	Direction arrow (with type of radio navigational facility, frequency, identification, morse code and distance/direction from the radio navigational facility to the aerodrome)	Richtungspfeil (mit Art der Funk-navigationsanlage, Frequenz, Kennung, Morsecode, Richtung und Entfernung von der Funknavigations-anlage zum Flugplatz)
9	Airport	Flugplatz
10	VFR Approach and Departure Route	VFR An- und Abflugstrecke
11	Traffic circuits (for Aeroplanes, ULM and Gliders)	Platzrunden (für Motorflugzeuge, ULM und Segelflugzeuge)
12	Sector boundary of airspace (C) (see above)	Sektorengrenze des Luftraumes (C) (siehe oben)
13	Natural Highpoint with Elevation (ft/MSL)	Höhenpunkt mit Höhenangabe (in Fuß/MSL)
14	Highest Elevation depicted on the chart (Lighted Obstacle with Elevation of top in feet/MSL)	Höchste gezeigte Erhebung auf der Karte (beleuchtetes Hindernis mit Spitzenhöhe in Fuß/MSL)
15	High Tension Line	Hochspannungsleitung
16	Variation	Ortsmissweisung
17	Railroad	Eisenbahnlinie
18	Road	Straße
19	Built-up Area	Bebautes Gebiet
20	Lake	See
21	Forest	Wald
22	Copyright Notes	Copyright Hinweis
23	Scale/Scalebars (NM, km)	Maßstab/Maßstabsbalken
24	Changes note (revisions incorporated)	Eingearbeitete Änderungen



Sample from Jeppesen VFR MANUAL



	English	Deutsch
	I. Header	**I. Kopf**
1	Location-/Airportname, Country	Orts-/Flugplatzname, Land
2	Revision date and Chart Index	Berichtigungsdatum und Karten-Ordnungsnummer
3	Aircraft admitted at the Aerodrome	Am Flugplatz zugelassene Luftfahrzeuge
4	Flight Information Service (FIS)	Fluginformationsdienst (FIS)
	II. Planview	**II. Karte**
5	Hard surface RWY (RWY length in meters and feet)	Befestigte Piste (Länge in Meter und Fuß)
6	Unpaved RWY (RWY length in meters and feet)	Unbefestigte Piste (Länge in Meter und Fuß)
7	RWY identification, magnetic orientation	Pistenbezeichnung, missweisende Ausrichtung
8	Taxiway with identification	Rollbahn mit Bezeichnung
9	Apron with Buildings, Air Traffic Reporting Office, Refuelling facility and Parking Area	Vorfeld mit Gebäuden, Luftaufsicht, Tankstelle und Abstellfläche
10	Strip for Gliders	Bahn für Segelflugzeuge
11	Signal or Landing-T; Wind Direction Indicator	Signalfeld oder Lande-T; Wind-richtungsanzeiger
12	Scalebars (Feet and Meters)	Maßstabsbalken (Fuß und Meter)
13	Facilities at the Aerodrome	Einrichtungen am Flugplatz
14	Aerodrome Lighting	Flugplatzbefeuerung
15	RWY length and width; Surface	Pistenlänge und-breite; Untergrund
16	Take-off run and Landing distance available	Verfügbare Startlauf- und Landestrecke
17	Strength of RWY	Tragfähigkeit der Piste
18	RWY lighted/unlighted	Piste befeuert/unbefeuert
19	Textinformation (depending on Country in English, French or German Language)	Textinformation (je nach Land in Englisch, Französisch oder Deutsch)
	IV. Border information	**III. Kartenrandinformationen**
20	Changes note (revisions incorporated)	Eingearbeitete Änderungen
21	Copyright notes	Copyright Hinweis



CALCULATED TAKE-OFF TIME

ATFM DEPARTURE SLOT

1. Definition

The Calculated Take-Off Time (CTOT) is the departure time slot also known as ATFM departure slot (air traffic flow management). The departure time slot is the time interval within which the take-off has to take place. The departure slot is defined to improve the traffic flow and avoid to jam-up the airspace.

If the assigned time slot is missed by the pilot, a new CTOT has to be requested to the controller. The pilot shall bear in mind that priority is given to aircraft which are respecting the assigned slot.

2. Regulation

2.1. General rules

Unless specific circumstances require application of a different priority rule, the controller shall allocate **departure slots in accordance with the first-planned first-served principle** (all the flights entering the regulated airspace are sequenced in the order they would have arrived in the absence of any restriction).

The circumstances that require different priority rules include :

- exclusion of certain traffic flows that enter but do not reduce the capacity of the location of the measure
- exclusion or forcing of specific flights in order to reduce excessive individual delays and optimise the use of capacity
- exclusion and prioritization of specific flights that are not able to benefit from rerouting measures due to overflight permissions or similar constraints

The following flights are exempted from ATFM measures:

- flights carrying Heads of State (or equivalent status);
- flights engaging in fire fighting
- flights conducting search and rescue operations;
- flights for life critical medical emergencies evacuations
- flights approved for exemption from ATFM measures by the appropriate ATS authority
- STS/ATFMX

Where a flight is subject to an ATFM departure slot, that slot is included as part of the air traffic control clearance.
Controllers (local ATFM units) shall be responsible for slot compliance monitoring within their area of responsibility.

2.2. Controller rules

Controllers shall be responsible for slot compliance at departure aerodromes:

- a slot tolerance is a window of time around a CTOT available to ATC which the aircraft must not depart outside
- ATS units shall provide all possible assistance to operators to meet ATFM slots or to coordinate a revised ATFM slot

In Europe, the departure slot is defined by Eurocontrol with a time tolerance of **-5 minutes and +10 minutes** around the CTOT.

In America, the CTOT is issued by the ATCSSC (Air Traffic Control System Command Center) using very similar procedures.

For example, if the assigned CTOT is 10h15, the aircraft cannot take off before 10h10 and after 10h25

Controllers shall suspend a flight plan when, considering the time tolerance, the ATFM departure slot cannot be met and a new estimated off-block time is not known.

3. Use of CTOT on IVAO

On IVAO, the departure slot assignment is mostly used in the case of large events. In these cases CTOT are issued in order to avoid that too many people connect at the same time, which can induce long waiting time for taking off and even large delay at the arrivals.

Several cases may be envisaged:

- In the case of a **specific event**, a booking form is available on the internet site of the event. Each booked flight is associated with a **CTOT** and the controllers must respect the CTOT list generated over the whole booking phase.
- In the case of **heavy load** on a platform, the controller may issue a **CTOT** to help the regulation of departures.

As is the case in real life, priority is given to pilots with an assigned CTOT and who are able to comply..

If the pilot is ready on time, ATC must handle the traffic in order to make the aircraft taking off within the assigned time slot.



AERODROME CHART

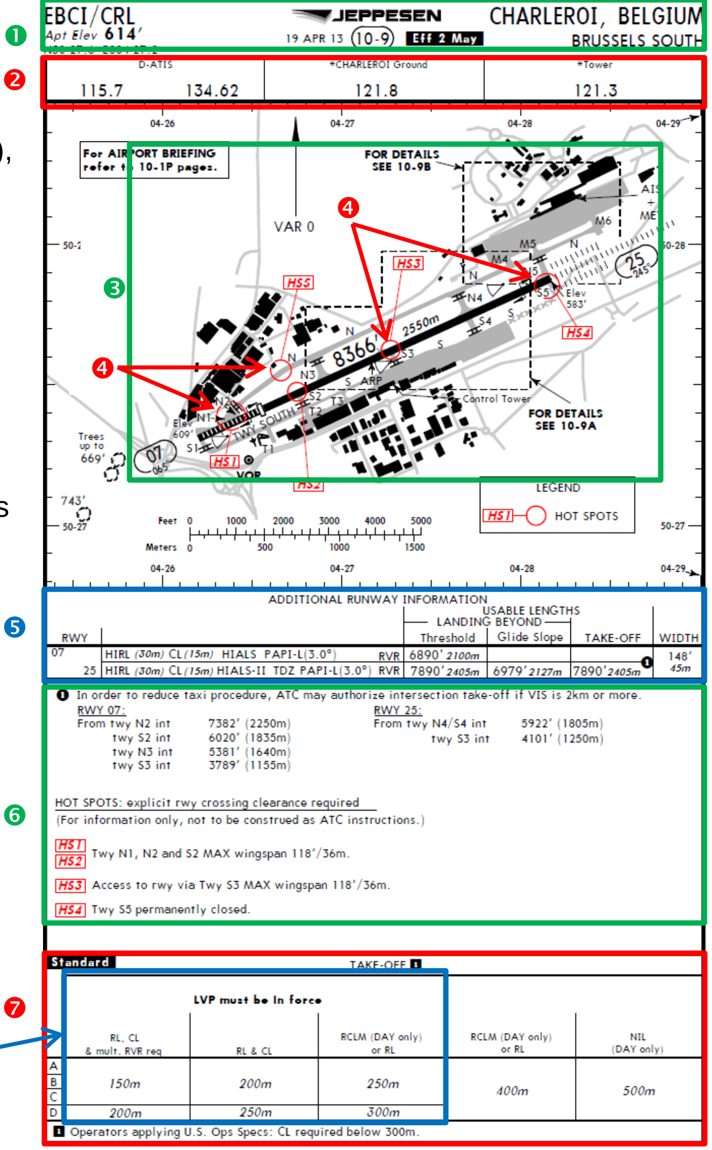
1. Introduction

In front of the initial approach charts of an airfield, there is usually an aerodrome chart.
This chart generally includes:

- Frequencies to be used for ground and tower controllers and ATIS
- Airport layout (runways, taxiways, apron…)
- Additional runway information
- Take-off minima
- Additional procedure on ground or in the air.

2. Description

1. Airfield ICAO/IATA code, name, country, Airport elevation altitude, date of publication
2. List of available frequencies (in MHz)
3. Ground layout including runway(s), taxiway(s), holding point(s), terminal and building…
4. Hot spot(s) to highlight dangerous areas (In terms of collision threats on the ground)
5. Additional runway information that contains
   - Runway light equipment
   - Runway landing/taking-off lengths
   - Runway width
6. Additional information : (in our example)
   - Taking off distance from holding points
   - Hot spots information …
   - All other useful information
7. Take-off RVR minima
8. Take-off RVR minima when LVP (Low visibility procedures) are in force





USE ALTIMETER SETTING

1. Introduction

One of the main instruments of the aircraft is the altimeter.

The altimeter must be tuned to the right pressure in order to have the right value displayed and to be compatible with other aircraft.

The altimeter shall be tuned with the local QNH on the ground most of the time.

2. Tune altimeter

Every pressure altimeter has a tune button in order to adjust the right pressure.

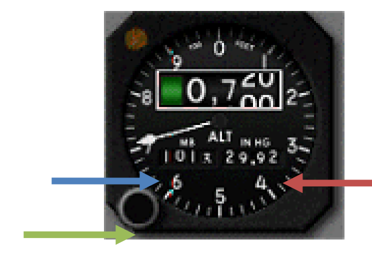
Depending on the aircraft equipment, the **pressure altimeter** will only accept a sub-setting:

- in **hecto Pascal (hPa)**
- **in inches of Mercury (in Hg).**

Example of an altimeter showing one or both units:

- red arrow = setting display in inHg
- blue = setting display in hPa
- green = tune button





Most altimeters in hectopascal do not show any decimals. In that case, select the nearest value.

To select 1013,25 in the aircraft, you must select 1013 hPa.

Some pressure altimeters show a millibar (mB) setting instead of hPa.
This is not a problem since 1 mB = 1 hPa.

This altimeter should be set only with:

- Local **QNH** pressure
- Local **QFE** pressure
- **Standard** pressure 1013hPa or 29,92 inHg

A pilot will receive **QNH** information from the Air Traffic Controller when:

- aircraft is cleared to descend to an altitude below the Transition Level (TL),
- during initial approach clearance (for IFR only)
- when cleared to enter the control zone (CTR) or the traffic circuit (mainly for VFR)
- sometimes as part of a taxi clearance
- pilot requests it
- the QNH changes.

3. Transition altitude and transition level

In order to have the altimeter settings, it is important to know the transition altitude and transition level in controlled areas.

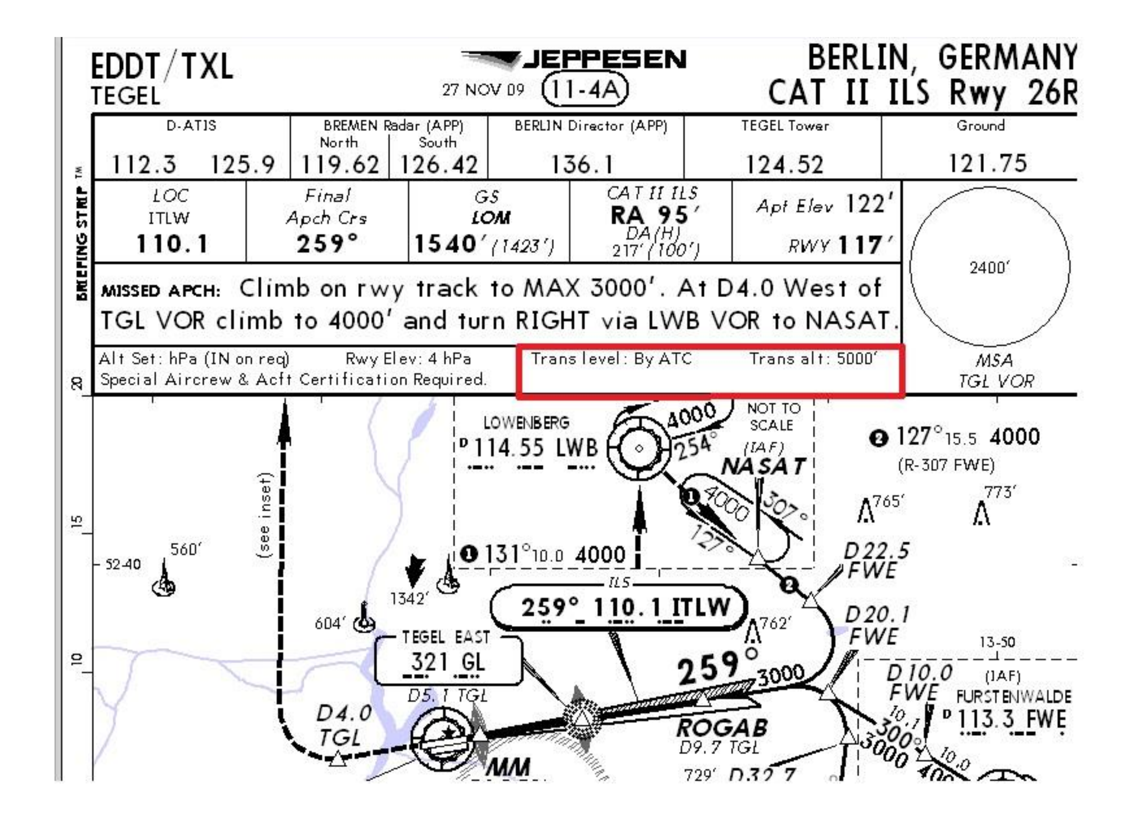
3.1. Transition altitude

The transition altitude is named **TA** in the charts.

You must know that:

- TA is published on charts in controlled areas
- TA is given in ATIS of controlled areas (Ground, Tower, Approach positions)
- TA is the maximum altitude where the altimeter setting is at local QNH
- TA can be identical in one or more countries, but TA can also be different in each airport of a country
- TA is defined for a TMA where it is published

Example of TA published on the charts of EDDT: TA =5000ft



When no transition altitude is published, no ATIS or no ATC are available, in the case you do not know the value of the transition altitude, the default transition altitude to be taken is a height of 3000ft (3000ft above the surface).

In Europe we have many TA in function of airport location (values from 3000ft to 12000ft).
In northern American countries, the TA is constant and equals to 18000ft.

3.2. Transition level

The transition level is named TL or TRL in the charts.

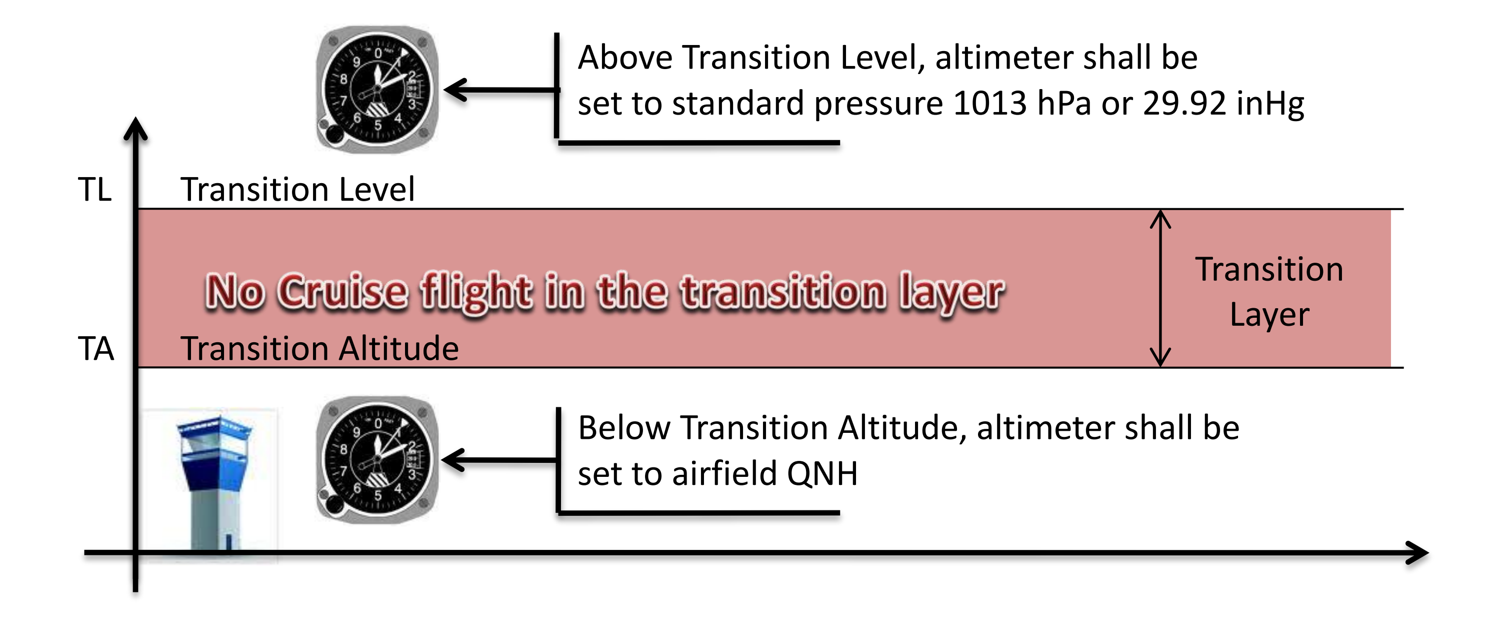
You must know that:

- TL is sometimes published on charts in controlled areas
- TL is sometime calculated by ATC for its controlled area in function of TA and local QNH
- TL is given in ATIS of controlled areas (Ground, Tower, Approach positions)
- TL is the minimum flight level where altimeter setting is at 1013 hPa (or 29.92 inHg)
- TL is the first usable IFR level above the transition altitude

3.3. Transition Layer

The transition layer is the gap between the TA and the TL.

No aircraft is allowed to make a stable cruise level in the transition layer gap.
Aircraft can only cross the transition layer.



Note that a typical transition layer is less than 1000ft. (the transition flight level is calculated to get this value).
Be careful, in some countries the transition layer can be less than 500ft or greater than 1000ft.

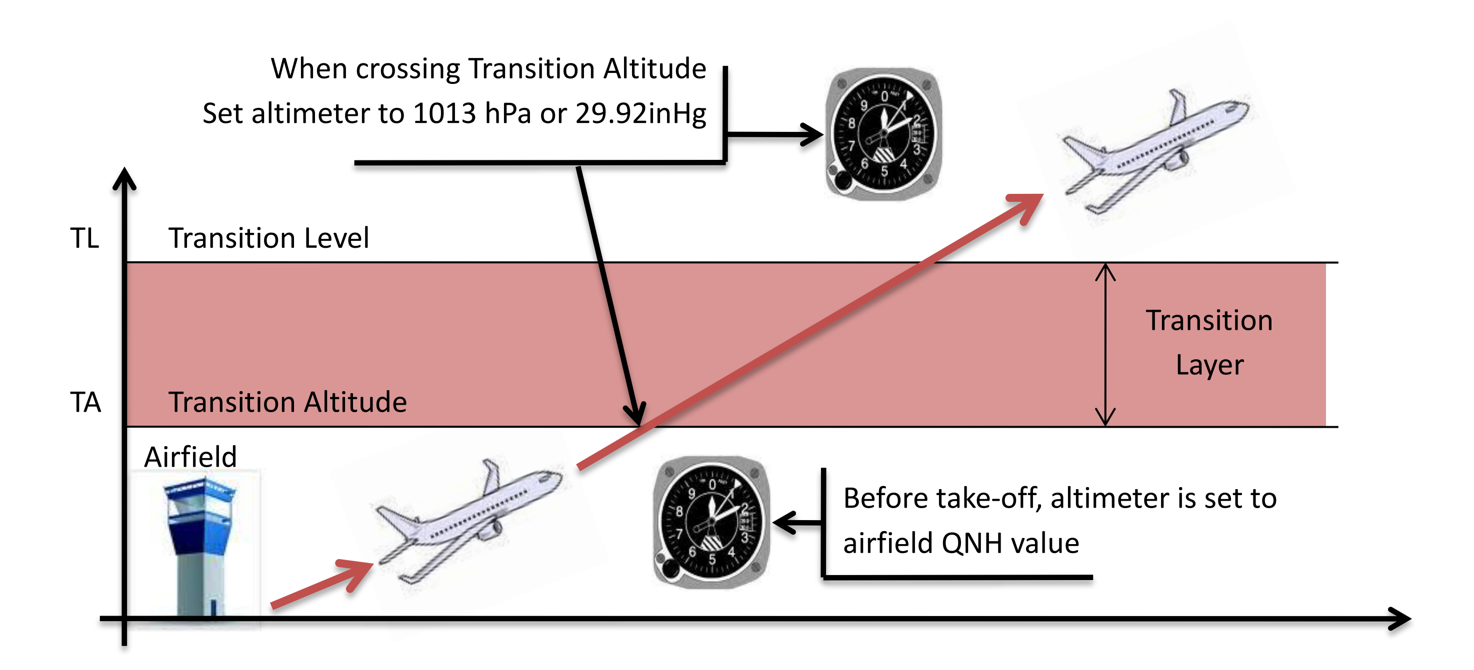
4. Use of altimeter setting

This chapter is showing practical information for **VFR** or **IFR pilots to correctly set their altimeter settings in time** during their flight.

4.1. During climbing - from ground to cruise flight level:

You will find the different steps to set the altimeter for departing aircraft:

1. On ground, the pilot shall set its altimeter at airfield QNH given by the airfield ATIS or given by ATC.
2. On ground, the pilot must take transition altitude and transition flight level values from charts or from the airfield ATIS (Pilot could ask ATC in service to get this information)
3. After take-off, the pilot shall monitor its altitude and compare it to transition altitude
4. At the time where the actual aircraft altitude is greater than the transition altitude, the **pilot without any ATC advice must set all his altimeter settings to 1013 hPa or 29.92 inHg**.
5. Then, the pilot verifies that he will cross the transition flight level to make sure that he never stabilizes in the transition layer.



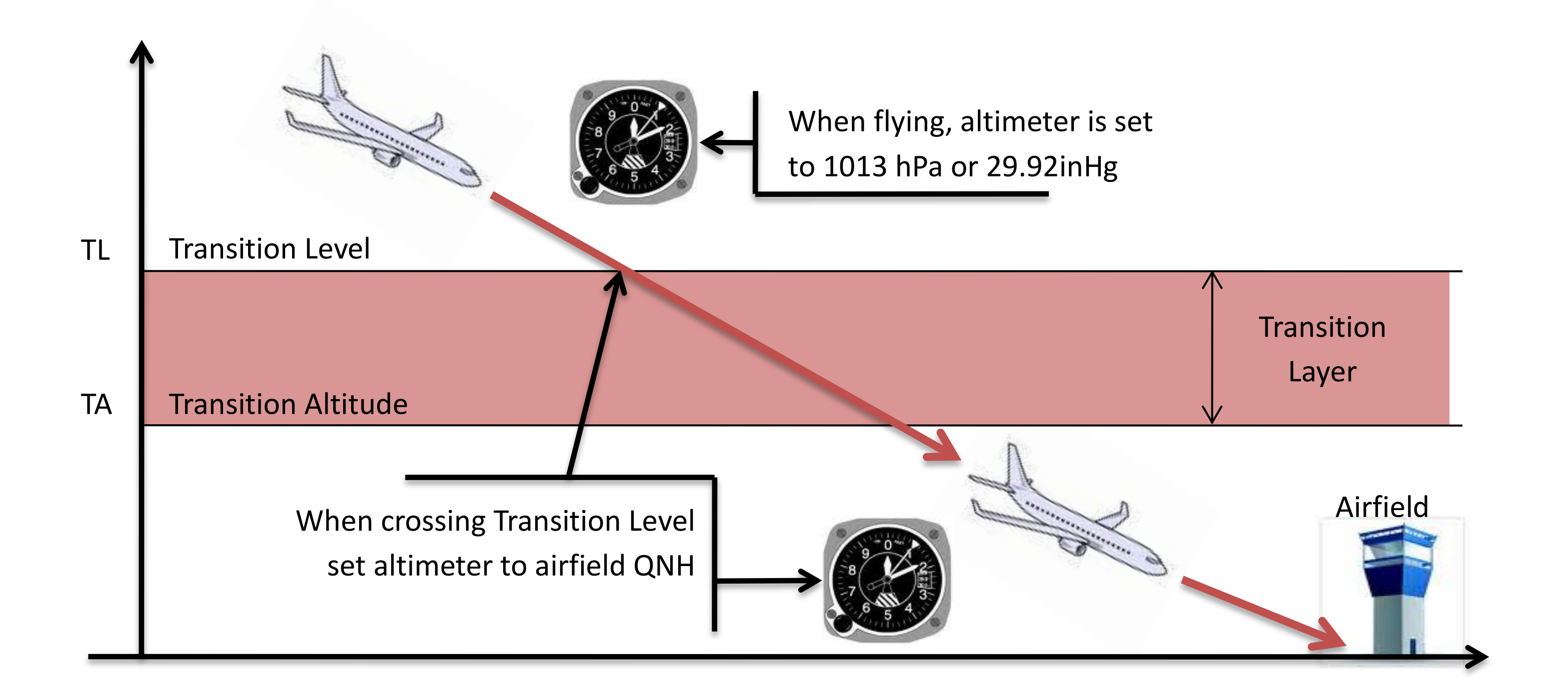
In conclusion, when the aircraft climbs and its altitude is greater than the transition altitude, the pilot without any ATC advice must set all his altimeter settings to 1013 hPa or 29.92 inHg.

Do not forget to set all altimeters and stand by altimeters.

4.2. During descent – from cruise flight level to airfield circuit/landing

You will find the different steps to set the altimeter for arriving aircraft:

1. When flying above transition flight level, the pilot shall already have set altimeter settings to 1013 hPA or 29.92 inHg.
2. When entering into a controlled area, the pilot must take transition flight level, transition altitude and local nearby QNH values (or airfield destination QNH) from airfield ATIS, from ATC in service or from charts.
3. When descending, the pilot shall monitor his current flight level and compare it to the transition level
4. At the time where actual aircraft flight level is lower than transition flight level, **the pilot without any ATC advise must set all his altimeter settings to local, destination or nearby airfield QNH**. Then, the pilot verifies that he will cross the transition altitude to make sure that he never stabilizes in the transition layer.



In conclusion, when the aircraft descends and its flight level is lower than the transition level, the pilot without any ATC advise must set all his altimeter settings to local, destination or nearby airfield QNH.

Do not forget to set all altimeters and stand by altimeters.



FLIGHT INSTRUMENTS

1. Introduction

The flight instruments are the instruments in the cockpit of an aircraft that provide the pilot with flight parameters.
The flight instruments are used in conditions of poor visibility when the pilot loses visual reference outside the aircraft.

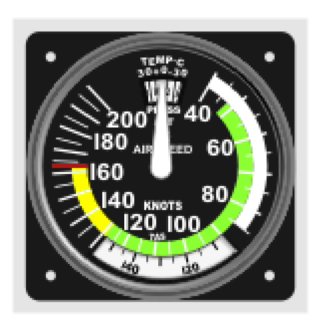
When you are sitting in the airplane, you will probably notice six flight instruments in front of you. The typical arrangement of these instruments is shown below:

1. Airspeed indicator
2. Attitude indicator
3. Altimeter
4. Turn coordinator
5. Heading indicator
6. Vertical speed indicator



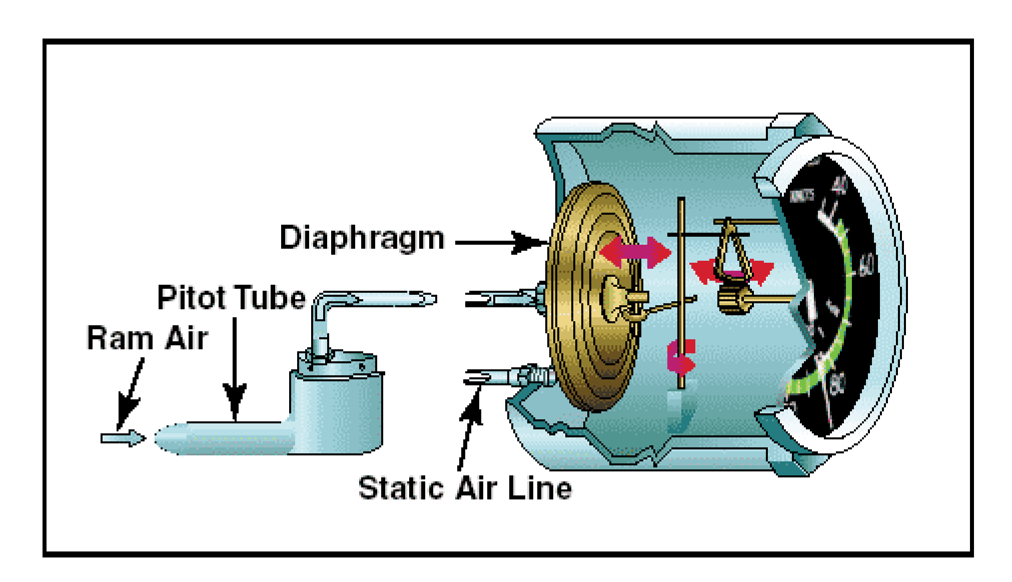
2. Airspeed indicator

The airspeed indicator (ASI) displays the speed at which the airplane is moving through the air.



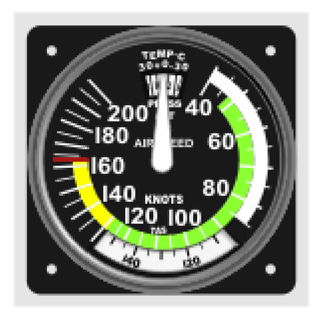
The direct instrument reading obtained from the airspeed indicator, uncorrected for variations in atmospheric density, installation error, or instrument error. Manufacturers use this airspeed as the basis for determining airplane performance.

The airspeed indicator is a sensitive differential pressure gauge which measures and shows the difference between impact pressure from Pitot tube, and static pressure from static line (the undisturbed atmospheric pressure at current flight level).



These two pressures will be equal when the airplane is parked on the ground in calm air. When the airplane moves through the air, the pressure on the pitot line becomes greater than the pressure in the static lines. This difference in pressure is registered by the airspeed pointer on the face of the instrument, which is calibrated in miles per hour, knots, or both.

The altimeter can display also other speed information:



- White arc: This arc is commonly referred to as the flap operating range since its lower limit represents the full flap stall speed and its upper limit provides the maximum flap speed (Approaches and landings are usually flown at speeds within the white arc.

- Lower limit of white arc (VS0): The stalling speed or the minimum steady flight speed in the landing configuration. In small airplanes, this is the power-off stall speed at the maximum landing weight in the landing configuration (gear and flaps down).

- Upper limit of the white arc (VFE): The maximum speed with the flaps extended.

- Green arc: This is the normal operating range of the airplane. Most flying occurs within this range.

- Lower limit of green arc (VS1): The stalling speed or the minimum steady flight speed obtained in a specified configuration. For most airplanes, this is the power-off stall speed at the maximum takeoff weight in the clean configuration (gear up, if retractable, and flaps up).

- Upper limit of green arc (VNO): The maximum structural cruising speed. Do not exceed this speed except in smooth air.

- Yellow arc: Caution range. Fly within this range only in smooth air, and then, only with caution.

- Red line (VNE): Never exceed speed. Operating above this speed is prohibited since it may result in damage or structural failure.

3. Attitude indicator

The attitude indicator displays a picture of the attitude of the aircraft.



There is also a miniature aircraft (orange line) and horizon bar representation.
The horizon is displayed using a white line which separates the instrument in two parts:

- the blue one which represents the sky
- the brown one which represents the earth.

The relationship of the miniature aircraft to the horizon bar is the same as the relationship of the real aircraft to the actual horizon. The instrument gives an instantaneous indication of even the smallest changes in attitude.

The gyro in the attitude indicator is mounted in a horizontal plane and depends upon rigidity in space for its operation. The horizon bar represents the true horizon. This bar is fixed to the gyro and remains in a horizontal plane as the aircraft is pitched or banked about its lateral or longitudinal axis, indicating the attitude of the aircraft relative to the true horizon.

This instrument is used to know about the attitude of the aircraft without any visual reference . With it, the pilot can know if the aircraft is:



climbing



descending



turning left



turning right

Note that the little orange triangle on the top shows the bank angle with the white graduation.

4. Altimeter

The altimeter displays the altitude of the airplane above mean sea level (MSL) when properly adjusted to the current pressure setting. The value is expressed in feet (ft); it can be meter (m) in some aircraft.



In aircraft, an aneroid barometer measures the atmospheric pressure from a static port outside the aircraft. Air pressure decreases with an increase of altitude—approximately 100 hectopascals per 800 meters or one inch of mercury per 1000 feet near sea level.

The analogic altimeter has 2 needles:

- The longest one for the hundreds of feet
- The shortest one for the thousands of feet



altitude = 3000ft



altitude = 5300ft

The direct value of the altimeter can be displayed directly in some instruments with only the long needle for hundreds of feet:



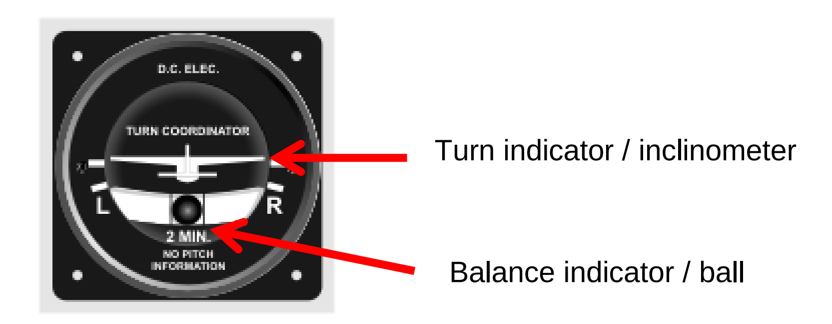
Altitude = 10500ft

Note that the altimeter shall be calibrated with the pressure value in hPa or inHg using the rotating knob on the bottom left or bottom right of the instrument.

The pressure chosen can be local airfield pressure QNH or standard QNH 1013 hPa / 29,92 inHg dependent on your altitude and country regulation.

5. Turn coordinator

The turn coordinator (turn and balance indicator) are essentially two aircraft flight instruments in one device. They each act as a rate of turn indicator that displays the rate the aircraft heading is changing and a balance indicator or slip indicator that displays the slip or skid of the turn.



The turn indicator display contains hash marks where the needle may align during a turn. When the needle is lined up with these hash marks, the aircraft is performing a standard rate turn.
The standard rate (or named rate “one”) for most airplanes is three degrees per second or two minutes per 360 degrees of turn (a complete circle). This is marked as "2 min" on the display.

The balance indicator information of the aircraft is often obtained by an inclinometer, which is recognized as the ball in a tube



Standard left turn



No turn in progress



Standard right turn

Note that in a standard turn, the ball in the balance indicator is always cantered.



Aircraft skidding to inside of turn



Coordinated Turn



Aircraft slipping to outside of turn

The turn coordinator should be used as a performance instrument when the attitude indicator has failed.

6. Heading indicator

The heading indicator is used to inform the pilot of the aircraft's heading.

It is sometimes referred to by its older names, the directional gyro and also direction indicator.



The heading indicator is fundamentally a mechanical instrument designed to facilitate the use of the magnetic compass. Errors in the magnetic compass are numerous, making straight flight and precision turns to headings difficult to accomplish, particularly in turbulent air.

To remedy errors in the magnetic compass reading, the pilot will typically manoeuvre the airplane with reference to the heading indicator, as the gyroscopic heading indicator is unaffected by dip and acceleration errors.

The primary means of establishing the heading in most small aircraft is the magnetic compass, which, however, suffers from several types of errors, including that created by the "dip" or downward slope of the Earth's magnetic field. Dip whenever the aircraft is in a bank, or during acceleration, making it difficult to use in any flight condition other than perfectly straight and level.

The pilot will periodically reset the heading indicator to the heading shown on the magnetic compass



Heading indicator shows 130°

7. Vertical speed indicator

The vertical speed indicator (VSI), called also variometer or a vertical velocity indicator, indicates whether the airplane is climbing, descending, or in level flight. The rate of climb or descent is indicated in feet per minute. If properly calibrated, the VSI indicates zero in level flight.



Aircraft maintain its altitude in level flight

The VSI does not display immediately an accurate indication of a climbing or descending rate. There exists a lag or a time between the initial changes in the rate of climb/descent and the display of this new rate.

Note that turbulence can extend the lag period and cause erratic and unstable rate indications.
In some aircraft a vertical speed indicator (IVSI) exists , which incorporates accelerometers to compensate for the lag in the typical VSI.



Aircraft descending -500ft/min

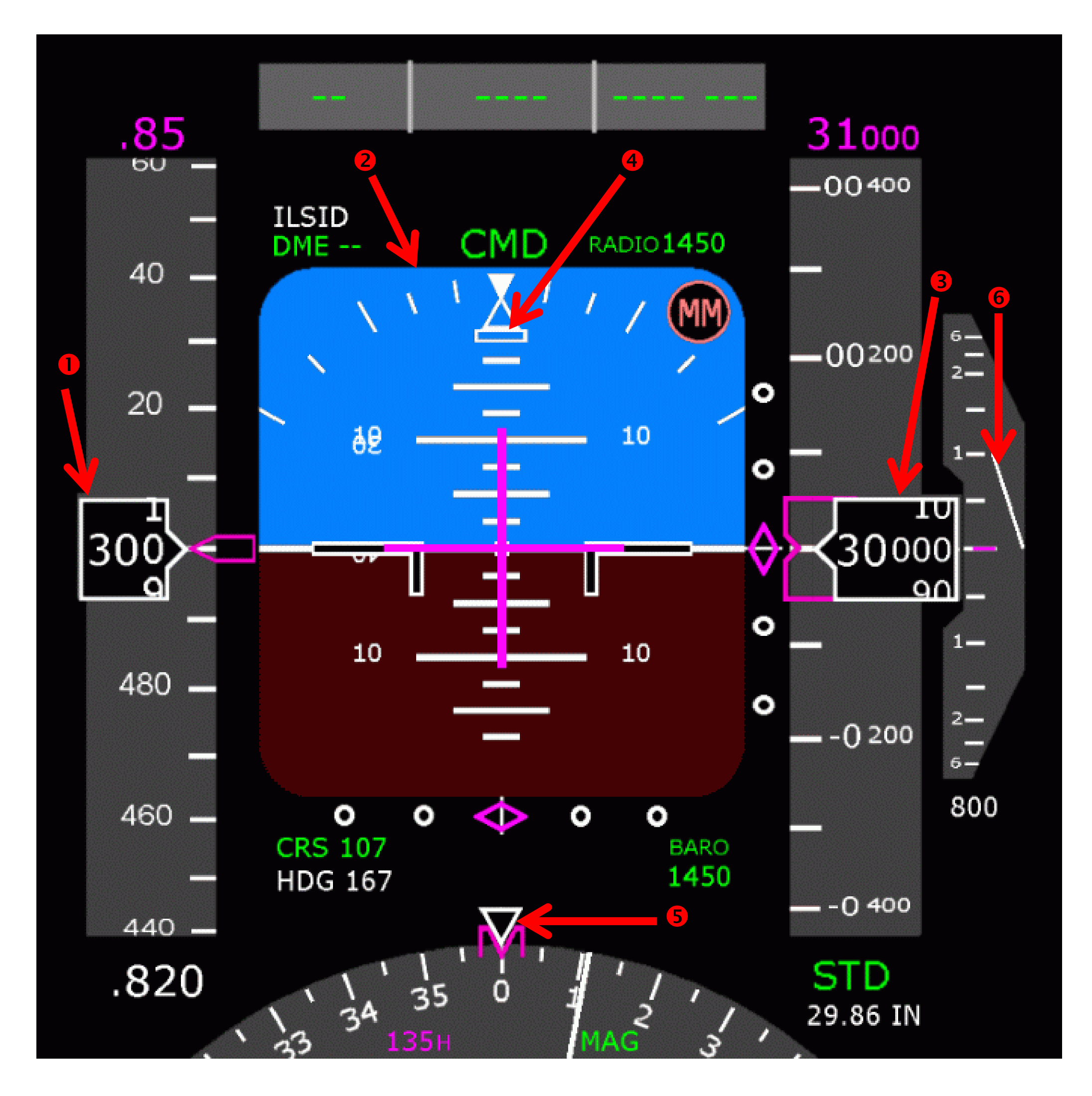


Aircraft climbing +800ft/min

8. Combined instrument

In some complex aircraft, the cockpit does not have the six separate instruments but one primary flight instrument named PFD which includes:

1. Airspeed indicator on the grey left bar (300)
2. Attitude indicator in the middle (blue and brown colored)
3. Altimeter on the grey right bar (30000)
4. Turn coordinator (shown by the white triangle and a white rectangle below “CMD” green text)
5. Heading indicator at the bottom centre (0°/360°)
6. Vertical speed indicator (grey trapezoid form on the right)



Of course, in function of aircraft, the primary flight display can differ, but you will find the same information near the same zone of instrument (airspeed indicator on the left, attitude indicator in the centre, altitude and vertical speed indicators on the right heading on the bottom…).



AIRSPEED DEFINITION

1. Introduction

Airspeed is the speed of an aircraft relative to the air.

We present the common conventions for qualifying airspeed:

- indicated airspeed = IAS
- calibrated airspeed = CAS
- equivalent airspeed EAS
- true airspeed = TAS
- ground speed = GS

2. Indicated airspeed – IAS

Indicated airspeed (IAS or KIAS) means the speed of an aircraft as shown on its pitot static airspeed indicator, calibrated to reflect standard atmosphere adiabatic compressible flow at sea level, uncorrected for airspeed system errors.

The pitot-static system comprises one or more pitot probes facing the in-coming air flow to **measure pitot pressure** (also called stagnation, total or ram pressure) and one or more static ports to measure the static pressure in the air flow.
The airspeed is derived from the difference between the ram air pressure from the pitot tube, or stagnation pressure, and the static pressure.
An airspeed indicator is a differential pressure gauge with the pressure reading expressed in units of speed, rather than pressure.

Indicated airspeed is simply what the airspeed indicator shows.

Most airspeed indicators show the speed in knots (KT) i.e. nautical miles per hour.
Other airspeed indicators may display miles per hour or kilometres per hour.

The static pressure measurement is subject to error due to the inability to place the static ports at positions where the pressure is true static pressure at all airspeeds and attitudes. The correction for this error is the position error correction (PEC) and varies for different aircraft and airspeeds.

Further errors of 10% or more are common if the airplane is flown in “uncoordinated” flight.

Indicated airspeed is the starting point for all other calculations.

3. Calibrated airspeed - CAS

Calibrated airspeed (CAS) is indicated airspeed corrected for instrument errors, position errors (due to incorrect pressure at the static port) and installation errors.

During clean flight, position and instrument errors are usually small. That means that the CAS value is nearly equal to the IAS.

This really only comes into play when the flaps are down.
What happens when the flaps are down? The angle of incidence of the pitot tube changes.
Rather than having the pitot tube aligned perfectly with the airflow, the center of lift is moved aft (how much depends on the type of flaps) and the pitot tube pitches slightly down.

Indicated airspeed will be a few knots lower. This is because the pitot tube is not picking up as many air molecules as it should, because of its angle of attack. Your real speed did not change, but the airspeed indicator thinks it did.

4. Equivalent airspeed - EAS

Equivalent airspeed (EAS) is the airspeed at sea level in the International Standard Atmosphere at which the dynamic pressure is the same as the dynamic pressure at the true airspeed (TAS) and altitude at which the aircraft is flying.

At standard sea level pressure, calibrated airspeed and equivalent airspeed are equal. Up to about 200 knots CAS and 10,000 feet the difference is negligible, but at higher speeds and altitudes CAS must be corrected for compressibility error to determine the EAS.

It really only comes into play with very high performance airplanes.

But for your own information, a pitot tube has a limit to how much air it can take in. If you fly faster than it can accept the air, then it will show an IAS that is less than what you would expect.

The basic definition for EAS is CAS corrected for compression air in the pitot tube.

5. True airspeed – TAS

True airspeed (TAS or KTAS) is the speed of the aircraft relative to the atmosphere. The true airspeed and heading of an aircraft constitute its velocity relative to the atmosphere

TAS is the true measure of aircraft performance in cruise, thus listed in aircraft specs, manuals, performance comparisons, pilot reports, and every situation when actual performance needs to be measured.
It is the speed listed on the flight plan, also used in flight planning, before considering the effects of wind.

5.1. Explanations

At sea level in the International Standard Atmosphere (ISA) and at low speeds where air compressibility is negligible, IAS corresponds to TAS.
When the air density or temperature around the aircraft differs from standard sea level conditions, the IAS will no longer correspond to TAS, thus it will no longer reflect aircraft performance. The airspeed indicator will indicate less than TAS when the air density decreases due to a change in altitude or air temperature.

For this reason, TAS cannot be measured directly. In flight, it can be calculated either by using an E6B flight calculator or its equivalent.

- For low speeds, the data required are static air temperature, pressure altitude and IAS
- Above approximately 100 knots, the compressibility error rises significantly and TAS must be calculated by the Mach speed.

If two airplanes (not linked together) had an indicated airspeed of 180kt, **the higher one would be going much faster**.
While there are only enough air molecules to give an indicated airspeed of 180kts, the true airspeed could be around 220kts (depending of the atmosphere condition: altitude and temperature).

Modern aircraft instruments use an Air Data Computer to perform this calculation in real time and display the TAS reading directly on the EFIS.

5.2. Calculation

The simplest way to compute true airspeed is using a function of Mach number:

$$TAS = a_0\,.\,M\sqrt{\frac{T}{T_0}}$$

TAS = True airspeed
a_0 = Speed of sound at standard sea level = 661.478 KT
M = Mach number
T = Temperature in Kelvin
T_0 = Standard sea level temperature (288.15 Kelvins)

One approximation is when temperature is at standard value (T=T_0):

$$TAS = a_0\,.\,M \;\approx 600\;\times\;Mach\,number$$

Since temperature variations are of a smaller influence, the airspeed indicator error can be roughly estimated as indicating about 2% less than TAS per 1,000ft of altitude above sea level (approximation for altitudes below 12000ft):

$$TAS = IAS + IAS \times (\frac{2}{100} \times \frac{Altitude}{1000})$$

Be aware that calculation is one of the possible approximations.

Example, an aircraft flying at 15,000ft with an IAS of 100kt:

$$TAS = 100 + \left(100 \ \times 0.02 \ \times \frac{15000}{1000}\right) = 100 + (100 \ \times 0.02 \ \times 15) = 130\ KT$$

At high speed (240KT<IAS<400KT), another approximation can be:

$$TAS = IAS + \frac{FL}{2} = IAS + \frac{Altitude}{200}$$

6. Ground speed – GS

Ground speed (GS) is the speed of the aircraft relative to the ground. This speed is the combination of the true airspeed vector of the aircraft and the speed vector of wind at aircraft altitude.

$GS = TAS + V_w$

GS = Ground speed
V_w = Wind speed vector
TAS = True airspeed

This speed is measured by air traffic controller radar. This is the speed which is displayed on our IVAO radar software IvAc.



AIRBORNE COLLISION AVOIDANCE SYSTEM - TCAS

1. Introduction

The TCAS or Traffic alert and Collision Avoidance System is a system designed to reduce the incidence of mid-air collisions with other aircraft.

The TCAS is independent of air traffic control and flight navigation instruments.

2. ICAO regulation

2.1. Definition and rules

Airborne collision avoidance system or ACAS is an aircraft system based on secondary surveillance radar (SSR) transponder signals which operate independently of ground-based equipment to provide advice to the pilot on potential conflicting aircraft that are equipped with SSR transponders.

The International Civil Aviation Organization prescribes that an Airborne Collision Avoidance System (ACAS) must be installed and operational for all aircraft heavier than 5700 Kg and all aircraft authorized to transport more than 19 passengers.

2.2. Types of ACAS

- **ACAS I** gives Traffic Advisories (TAs) but does not recommend any manoeuvres. The only implementation of the ACAS I concept is TCAS I. These equipments are limited to interoperability and interference issues with ACAS II.
- **ACAS II** gives Traffic Advisories (TAs) and Resolution Advisories (RAs) in the vertical sense (direction). The only implementations of the ACAS II concept are TCAS II Version 7.0 and Version 7.1.
- **ACAS III** gives TAs and RAs in vertical and/or horizontal directions. ICAO SARPs for ACAS III have not been developed. Currently, there are no plans to proceed with such a development

Not all TCAS systems can be considered as accepted ACAS.
TCAS I is mandated in the United States for certain smaller aircraft.
TCAS II Versions 7.0 and 7.1 are mandated in Europe and elsewhere
Collision avoidance systems can be passive, like for example the **PCAS** or **Portable Collision Avoidance System** which only monitors the surrounding aircraft without emitting any signal. This portable system is often used within General Aviation.

2.3. ACAS II as a standard

Currently, the only commercially available implementations of ICAO standard for ACAS II (Airborne Collision Avoidance System) are TCAS II versions 7.0 and version 7.1 (Traffic alert and Collision Avoidance System).

ACAS II is an aircraft system based on Secondary Surveillance Radar (SSR) transponder signals.
ACAS II interrogates the Mode C and Mode S transponders of nearby aircraft ('intruders') and from the replies tracks their altitude and range and issues alerts to the pilots, as appropriate.
ACAS II works independently of the aircraft navigation, flight management systems, and Air Traffic Control (ATC) ground systems.

Non-transponding aircraft are not detected.

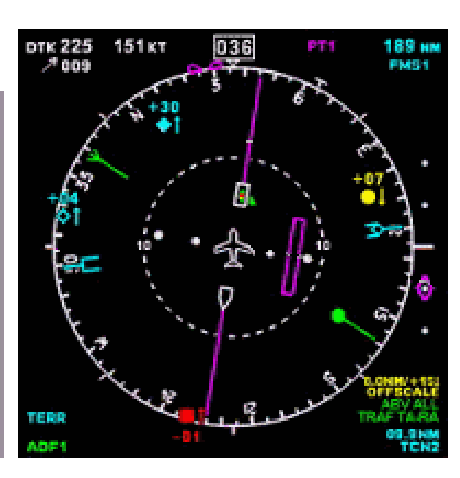
3. TCAS instrument onboard

The TCAS system can be implemented as:

- a dedicated instrument
- a combined instrument with the vertical speed indicator
- a combined instrument with the Navigation Display or the Electronic Horizontal Situation Indicator







3.1. Different modes

TCAS can be currently operated in the following modes:

- **Standby**: TCAS does not issue any interrogations and the transponder only replies to discrete interrogations. This mode is used on the ground, outside of the runway.
- **Transponder**: the transponder replies to all appropriate ground and TCAS interrogations and TCAS remains in stand-by. This is a passive mode which is the minimum mandatory mode to be set by any airborne aircraft (typically in General Aviation)
- **Traffic Advisory (TA)**: TCAS issues the appropriate interrogations and perform all tracking functions. However, TCAS will only provide traffic advisories (TA) and the resolution advisories (RA) are inhibited
- **Automatic (TA/RA)**: TCAS provides traffic advisories (TA) and resolution advisories (RA) when appropriate. This mode is mandatory for all Commercial Aviation aircrafts.

4. Technical description

The TCAS II is a system that:

- Monitors the airspace around the aircraft and communicates with all traffic equipped with a corresponding active transponder
- Queries all surrounding aircraft on the frequency 1030 MHz and each aircraft transponder replies on the frequency 1090MHz
- Warns pilots of the presence of other transponder-equipped aircraft which may present a threat of mid-air collision (MAC)

TCAS is only able to interact with aircraft that have a correctly operating mode C or mode S transponder.

4.1. Definition

TCAS II equipment provides two types of advisories to pilots: Resolution Advisories (RAs) and Traffic Advisories (TAs).

These are defined as follows:

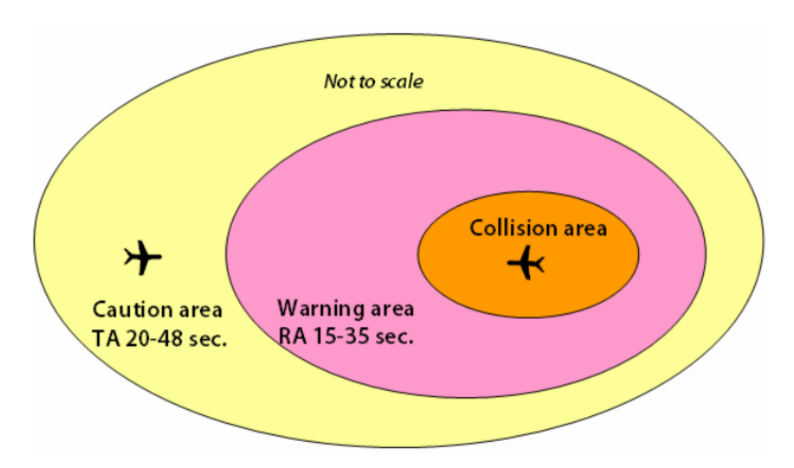
- Resolution advisory (RA) is an indication given to the flight crew recommending:
  - ➢ a manoeuvre intended to provide separation from all threats, or
  - ➢ a manoeuvre restriction intended to maintain existing separation.
- Traffic advisory (TA) is an indication given to the flight crew that a certain intruder is a potential threat.

4.2. Protection volume

A protected volume of airspace surrounds each ACAS II equipped aircraft.
The size of the protected volume depends on :

- the altitude of the aircraft involved in the encounter.
- the speed of the aircraft involved in the encounter.
- the heading of the aircraft involved in the encounter.

The TCAS system builds a three dimensional map (Protection Volume) of the airspace around the aircraft. The map range depends on the TCAS configuration.



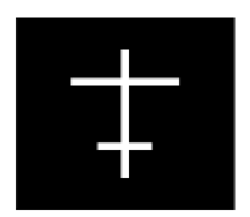
4.3. TCAS symbols

The map is filled with all intruder aircraft depending on:

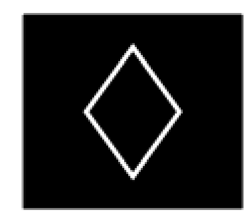
- their distance (deduced from the interrogation and response round trip time)
- their altitude (as reported by the interrogated aircraft)
- their bearing (by the directional antenna from the response)

Traffic is represented by small geometrical symbols with associated numbers indicating the vertical separation with respect to your airplane, expressed in hundreds of feet.
For example:

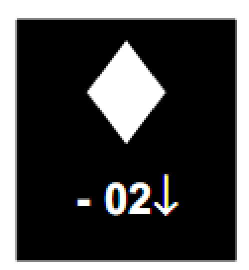
- -012 = 1200 feet below
- 121 = 12100 feet above
- -02↓ = 200 feet below and descending
- +07 = 700 feet above
- -01↑= 100 feet below and climbing



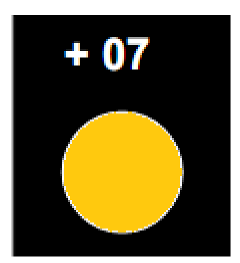
Symbol of your aircraft



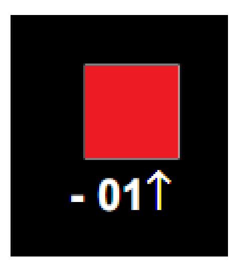
Symbol of non-threat traffic of unknown altitude
(empty diamond with white or blue borders)
Separation > 1200 ft or distance > 6 NM



Symbol of a non-threat proximity traffic
(full white or blue diamond)
Separation < 1200 ft or distance < 6 NM



Symbol of a Traffic Advisory - TA alert
(full orange or amber circle)



Symbol of a Resolution Advisory –RA alert
(full red square)

4.4. Advisories

Finally, by extrapolating the current range and altitude difference to anticipated future values, the system determines whether a potential collision threat exists.

TCAS is also an active system since it reports to the pilot the position of all aircraft inside the protected volume and warns the pilot about any risk of conflict.

Following the identification of potential collisions, the TCAS automatically negotiates a mutual avoidance manoeuvre (currently, manoeuvres are restricted to changes in altitude and modification of climb/sink rates) between the two (or more) conflicting aircraft. These avoidance manoeuvres are communicated to the pilot by a cockpit display and by synthesized voice instructions.

4.4.1. Traffic Advisory (TA)

In the case of a potential collision, a sounding alert is emitted by the "Traffic Advisory" (TA). This system warns the pilot about every intruder aircraft by a "traffic, traffic" vocal announcement. It does not provide any avoidance manoeuvre suggestion.

TAs are nominally generated 20–48 seconds prior to the predicted Closest Point of Approach which would be 10–13 seconds earlier than any RA, although shorter generation times are possible in some geometries – indeed, in certain cases an RA can occur without a preceding TA. The majority of TAs will not be followed by an RA because often the separation between the aircraft does not drop below the alert threshold for an RA. On average, only 1 in 10 TAs will be followed by an RA.

When a TA is issued, the pilot is meant to initiate a visual search for the traffic causing the TA. If the traffic is visually identified, the pilot has to maintain visual separation.
He is also supposed to avoid any horizontal manoeuvre based on the solely information shown on the traffic display. On the contrary, slight adjustments in vertical speed while climbing or descending, or slight adjustments in airspeed while still complying with the ATC clearance are acceptable.

TA alerts shall not be used by the pilot to separate himself with other pilots especially in controlled area.

4.4.2. Resolution Advisory (RA)

Whenever the conflict situation gets worst after a TA alert and the collision seems impending, an audio message and a visual alert are generated by the « **R**esolution **A**dvisory » (**RA**). This alert indicates the concerned airplane and suggests an avoidance action to be immediately executed by the pilot.

The system is conceived in such a way that the TCAS of the other airplane suggests another action.

For example when the TCAS provides a climb advisory to one airplane, the TCAS of the other aircraft suggests a descent suggestion, which gives an increased separation between the two aircraft.

Although the system may sometimes cause false alerts, pilots are instructed to strictly consider all TCAS messages as real alerts which require an immediate action.
In the case of a difference between the TCAS RA and ATC instructions, the TCAS RA has always priority.

As soon as the alert disappears, the system announces « **clear of conflict** ».

4.4.3. List of TCAS advisories

The list of TCAS advisories is presented below:

Type	Audio	Meaning	Required action
TA	Traffic, traffic	Intruder is close both horizontally and vertically	Attempt visual contact and be prepared to manoeuvre if an RA occurs
RA	Climb, climb	Intruder will pass below	Begin climbing at 1500–2000 ft/min
RA	Descend, descend	Intruder will pass above	Begin descending at 1500–2000 ft/min
RA	Increase climb	Intruder will pass just below	Climb at 2500 – 3000 ft/min
RA	Increase descent	Intruder will pass just above.	Descend at 2500 – 3000 ft/min
RA	Adjust vertical speed, adjust	Intruder is probably well above or below	Descend or climb at a slower rate
RA	Climb, climb now	Intruder that was passing above will now pass below	Change from a descent to a climb
RA	Descend, descend now	Intruder that was passing below will now pass above	Change from a climb to a descent
RA	Maintain vertical speed, maintain	Intruder will be avoided if vertical rate is maintained	Maintain current vertical rate
RA	Adjust vertical speed, adjust	Intruder is considerably away or the initial RA is weakening	Begin to level off
RA	Monitor vertical speed	Intruder is ahead in level flight, above or below	Remain in level flight
RA	Crossing	Passing through the intruder's level. Usually added to any other RA.	Proceed according to the associated RA
RA	Level off, level off	Intruder is no longer a threat while maintaining this level	Maintain current level (no climb, no descent)
CC	Clear of conflict	Intruder is no longer a threat	Return promptly to previous ATC clearance

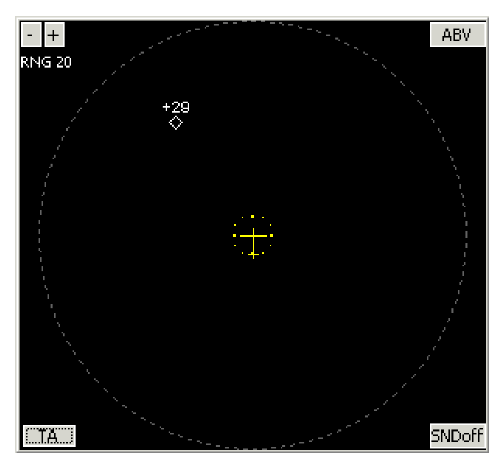
5. TCAS in IVAO

The TCAS is a function available in IvAp 1.6 & 2.0 and x-IvAp 0.3 version or above.

This means that it is always available regardless the aircraft model you choose, even for airplanes which are not equipped in real life. It is up to you to make use of it or not depending on the aircraft you fly with and on the degree of realism you wish to reach.

On IVAO, the TCAS function is useful when ATC is not present in order to prevent collision.

5.1. TCAS representation



IvAp for FS9/FSX



x-IvAp for X-plane

5.2. Use of TCAS

The symbol of your aircraft is placed in the middle of a circle in the TCAS window

The radius of this circle can be increased or decreased by clicking on « **+** » or « **-** ». The range possible values are **3**, **5**, **10**, **15**, **20** or **40** NM.

The TCAS activation button is placed on the left bottom corner of the window. The different modes are:

- **OFF**: (inactive TCAS) with « TCAS OFF »
- **TA**: « Traffic Advisory » mode
- **TA/RA**: « Traffic Advisory/Resolution Advisory » mode

For the time being, IvAp is not able to handle the TCAS II functions, namely RAs, since avoidance manoeuvres cannot yet be coordinated between two aircraft (this function is foreseen for a later release). IvAp TCAS is a ACAS I system only.

The display mode can be changed with the button placed on the right top corner:

- **NORM**: the traffic at +/- 2700 ft is displayed
- **ALL**: all traffic within the TCAS range is displayed
- **ABV**: the traffic within the interval (-2700, +9000) ft is displayed
- **BLW**: the traffic within the interval (-9000, +2700) ft is displayed

Finally, the TCAS sound can be deactivated or activated by the right bottom button.

5.2.1. TCAS Caution

A TCAS “Caution” is issued whenever an airplane is at ±1600 ft and/or at 7 NM from your position. The intruder aircraft is displayed in yellow.

5.2.2. TCAS Alert

A TCAS “Alert” is issued whenever an airplane is at ±900 ft and/or at 3 NM from your position. The intruder aircraft is displayed in red.

When a TCAS alert is issued, the reaction time allowed to you is very short.
You must execute all possible manoeuvres to avoid the collision and inform the ATC when available.

In the case of a high load traffic situation, it is extremely important to inform the ATC as soon as possible in order to avoid conflicts with other aircraft.



NAVIGATION INSTRUMENTS - BASICS

1. Introduction

Several radio-navigation instruments equip the different airplanes available in our flight simulators software.

The type of instrument that can be found on a specific airplane depends on its level of sophistication: a light VFR plane is equipped with simple instruments while a jet needs quite much more complex devices to ensure proper navigation.

Despite the very large variety of equipment that can be found in many aircraft, the main radio-navigation instruments listed below are not numerous and provide all functions needed to perform IFR navigation:

- **NDB** receptor (Non Directional Beacon)
- **VOR** receptor (VHF Omnidirectional Range)
- **DME** receptor (Distance Measurement Equipment)
- **ILS** receptor (Instrument Landing System)
- **GPS** receptor (Global Positioning System)

Information from these receptors is displayed on the radio-navigation instruments which are listed below:

- **ADI** (Attitude Director Indicator) or **EADI** (Electronic ADI),
- **ADF** (Automatic Direction Finder)
- **HSI** (Horizontal Situation Indicator) or **EHSI** (Electronic HSI)
- **RMI** (Radio Magnetic Indicator)
- **CDI** (Course Direction Indicator)
- **EFIS** (Electronic Flight Instruments System) which includes :
- **PFD** (Primary Flight Display)
- **ND** (Navigation Display)

Some supplementary systems are not available on basic aircraft but some can be integrated through add-ons:

- **TACAN**
- **LORAN**
- **OMEGA**
- **MLS**
- **INS**
- **HUD**
- **FMS / FMC**

2. The NDB equipment

A Non Directional Beacon (NDB) is a radio station placed in an identified location and it is used as an aviation or maritime navigation aid. In the aviation, the NDB use is regulated by the annex 10 of ICAO which specifies that NDB are exploited over a frequency range between 190 and 1750 kHz (in Europe this range is reduced within 255 and 525 kHz).

These beacons are mostly located near airports since they provide the simplest navigation information to reach an airport.
A NDB is characterized by its range:

- **Long range** (**100 NM**): it is used as a reference point for en route navigation but also as a holding fixe or an initial approach fixe (IAF) near airports.
- **Small range** (**25 NM**): it is essentially used as a holding or initial approach fixe near airports. In some countries, when NDB are used as IAF, they are often called locators.

The signals from a NDB are received by an instrument on the airplane called ADF (Automatic Direction Finder).

2.1. The ADF selector

In most airplanes, the NDB frequency is set into the ADF selector which can be found on the radio panel:



ADF selector on a Boeing radio panel



ADF selector on a Beechcraft radio panel

2.2. The ADF bearing display

The NDB signal is received by the ADF which automatically and continuously displays the relative bearing from the aircraft to the selected NDB.



ADF display on a Cessna

The NDB bearing can also be displayed on a radio-compass or RMI (Radio Magnetic Indicator):






RMI equipment

In modern jets, the simple ADF display is integrated into the Electronic Horizontal Situation Indicator (EHSI). The blue arrow indicates the NDB bearing (the direction towards the NDB, heading 150° in the example below).





EHSI equipment

3. The VOR equipment

A VHF Omnidirectional Range (VOR) beacon is a short-range radio-navigation system enabling aircraft with a receiving unit to determine their position and stay on a given course.

The VOR beacon simultaneously transmits two signals, a constant omnidirectional signal called the *reference phase* and a *directional signal which rotates* through 360°, during a 0.03 second system cycle, and consistently varies in phase through each rotation. The two signals are only exactly in phase once during each rotation – when the directional signal is aligned to magnetic north.

VOR are exploited over the Very High Frequency (VHF) band from 108 to 117.95 MHz with channels spaced of 50 or 100 kHz (50 kHz for dense zones, 100 kHz elsewhere). The first 4 MHz is shared with the ILS band, the VOR being allocated to 160 of the 200 available channels. To leave channels for the ILS, in the range 108.0 to 111.95 MHz, the 100 kHz digit is always even. Of these 160 channels, 120 are allocated to VOR stations intended for en route navigation while the other forty are for terminal VOR stations.

Two types of VOR beacons are used:

- **Terminal VOR** (**T-VOR**): it is used in the terminal area of airports and covers a relatively small geographic area protected from interference by other stations on the same frequency. T-VOR output power is 50 W which allows covering a region from 1000 ft AGL up to and including 12000 ft AGL at radial distances out to 25 NM. The allocated band ranges from 108 to 111.850 MHz with the 100 kHz digit being always even.
- **En route VOR**: they are used as route fixes within high or low airspace. Their output power is 200 W which provides a range up to 200 NM. The allocated band ranges from 112 to 117.950 MHz

A VOR receiver enables the aircraft to determine its bearing with respect to the beacon (the position of which is known). From the phase shift measurement, the VOR receiver enables to determine the direction in degrees, called the **radial**, from the station to the aircraft.

From the radial detection, the aircraft can follow any course passing through the VOR station, either inbound or outbound. Crossing two VOR radials allows the determination of the exact position of an aircraft.

The VOR station is often coupled to a DME system to provide a distance measurement between the aircraft and the beacon.

3.1. The VOR selector

In all planes, the frequency of a VOR is set into the NAV1 and NAV2 selector which can be found on the radio panel:

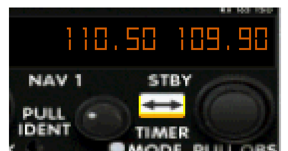


Boeing radio panel to select NAV1 and NAV2

Many panels have two frequencies:

- one active located at the left of the frequency selector
- one stand by located at the right of the frequency selector

The stand by frequency is used to prepare the right frequency before transferring it to active. (next frequency preparation).





Beechcraft radio panel to select NAV1 and NAV2



Other radio panel to select NAV1 and NAV2

The NAV1 selector is common to the VOR and ILS. Only the frequency set is able to differentiate the two systems.

3.2. The VOR course display

The VOR signal is analyzed by a receiver and displayed by a Course Deviation Indicator (CDI).





CDI 1 and 2 equipment of a Cessna

The white vertical bar indicates the position of the selected radial with respect to the airplane course. In this example, the radial, selected with the OBS (Omni Bearing Selector), is on the left of the aircraft. The white triangle is the TO/FROM indicator (in this example the selected radial is inbound). The CDI1 also displays the ILS glide slope (horizontal bar).

-



Horizontal Situation Indicator (HSI) of a Beechcraft

The yellow vertical bar indicates the position of the selected radial with respect to the airplane course.
The white triangle is the TO/FROM indicator (in this example the selected radial is inbound).

The VOR course can also be displayed on a radio-compass or RMI (Radio Magnetic Indicator):



RMI equipment



EHSI equipment

The pink vertical bar indicates the position of the selected radial with respect to the plane (VOR AN 110.50)
The green indicator works in RMI mode and indicates the direction of the VOR beacon (VOR AVN 112.30).

4. The DME equipment

A Distance Measuring Equipment (DME) is a radio-transponder which allows knowing the distance from the airplane to a ground station. It measures the time spent by a UHF (Ultra High Frequency) radio signal to make the round trip between beacon and the airplane. More precisely, it measures the slant range, i.e. the hypotenuse of the triangle represented by the altitude of the aircraft and the distance between the radar antenna and the aircraft's ground track.

Whenever a DME is coupled to a VOR or an ILS, it is automatically displayed by the selection of the VOR or ILS frequency. Otherwise, like in TACAN, the DME frequency must be specifically set.

4.1. The DME display

In some airplanes, the DME measurement can be found on the radio panel, associated with the ground speed of the airplane.



DME display in a Cessna

In this example the DME distance is 27.5 NM and the ground speed is 98 kt.



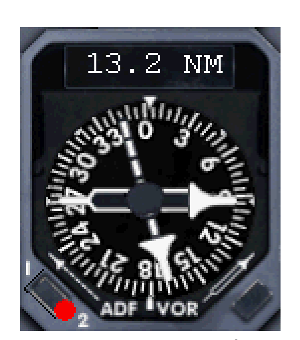


EHSI equipment

In this example the DME distance is 0.5 NM from the VOR AN (110.50).

The AVN VOR is not equipped with a DME and the lack of distance information is indicated with '- - - -'

The DME measurement can also be integrated into a RMI display:



RMI equipment with DME

5. The ILS equipment

The Instrument Landing System (ILS) is the most precise navigation equipment used in IFR flight.
It is today the most used precision approach system in our current flight simulators.

It is composed of at least two of the following elements:

- A **Localizer** (LOC) which provides the horizontal deviation with respect to the runway axis. The LOC frequencies range between 108.10 MHz and 111.95 MHz (with the 100 kHz first decimal digit always odd) and are not used for any other purpose.
- A **Glide Slope** (GS, or Glide Path GP) which provides the vertical deviation with respect to the nominal approach slope (most commonly 3°). The GP signal is in the 330 MHz (UHF) range.

Together with the previous, two other pieces of equipment can be also available:

- A **DME** which provides the distance between the LOC and the airplane
- A (set of) **MARKER** beacon(s) which provides a light and a sound indication at a published distance from the runway threshold.

The certified range is 15-20 NM (25 NM in flight simulator) for the LOC and slightly less for the GS. The glide information is not reliable anymore when going below 50ft AGL.

In practice, the pilot sets **only the LOC frequency** since the GS (and eventually the DME) frequencies are paired to the LOC frequency.

The Localizer (LOC) provides only one of the two fundamental functions of an ILS. However, some small airports do not dispose of a full ILS but only the localizer part.

5.1. The ILS selector

In most airplanes, the frequency of the ILS (or the LOC) is set into the NAV1 selector on the radio panel.



Boeing radio panel to select NAV1



Beechcraft radio panel to select NAV1

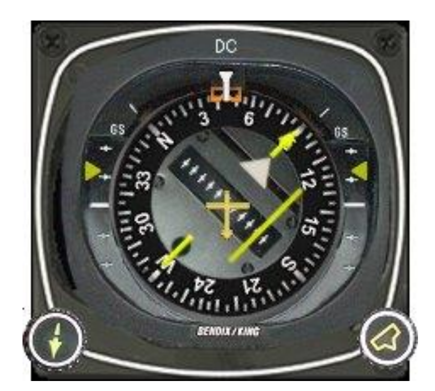
5.2. The ILS display

The two ILS signals (LOC and GS) are displayed on the following instruments.



CDI 1 equipment of a Cessna

The white vertical bar indicates the localizer course (in this example the runway axis is on the left). The white horizontal bar indicates the glide (in this example the glide slope indicates that the plane is over the approach slope; when the glide is inactive, the rectangle GS is filled with red and white stripes).



HSI equipment of a Beechcraft

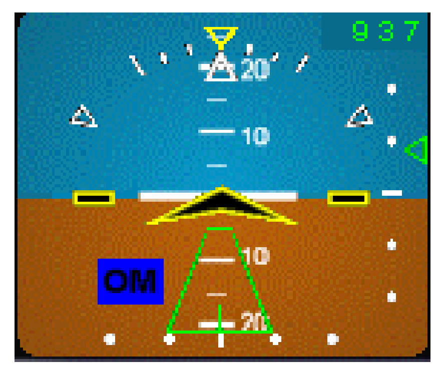
The yellow vertical bar indicates the localizer course (in this example the runway axis is on the right). The glide marker is indicated by the two yellow arrows on the left and right borders of the HIS (named GS).



EHSI equipment

The pink vertical bar indicates the localizer course (in this example the runway axis is on the left).

In some airplanes, the ILS is displayed on the Electronic Attitude Direction Indicator (EADI).



PFD/EADI equipment

The green rectangle indicates the localizer course and the glide marker is indicated by the green arrow on the right border of the EADI.

5.3. The MARKER beacons

MARKER beacons provide a light and a sound indication at a published distance from the runway threshold. They operate at a carrier frequency of 75 MHz and are going to be replaced by a systematic use of a DME coupled to the LOC.

Three beacons can be available:

- **Outer Marker** (OM): it normally identifies the Final Approach Fix (FAF) and is situated on the same course/track as the LOC and the runway center-line, 4 to 7 NM before the runway threshold. It is typically located about 1 NM inside the point where the GS intercepts the intermediate altitude. The outer marker is often coupled to a NDB (Locator Outer Marker)
- **Middle Marker** (MM): it is normally positioned 0.5 to 0.8 NM before the runway threshold and is used to alert the pilot that the CAT I missed approach point (typically 200 ft AGL) has been passed.
- **Inner Marker** (IM): it is located at the threshold of the runway on some ILS approach systems (usually Category II and III) having decision heights of less than 200 ft AGL.

Marker beacons can be indicated on the EADI (see figure above) but also close to the radio panel:



6. The GPS equipment

The Global Positioning System (GPS) permits earth-centered coordinates to be determined and provides the aircraft position referenced to the World Geodetic System. Satellite navigation systems are unaffected by weather and provide global navigation coverage that fully meet the civil requirements for use as the primary means of navigation in oceanic airspace and certain remote areas.

Navigational values, such as distance and bearing to a waypoint and groundspeed, are computed from the aircraft's current position (latitude and longitude) and the location of the next waypoint. Course guidance is provided as a linear deviation from the desired track of a Great Circle route between defined waypoints.

GPS operation is based on the concept of **ranging and triangulation from a constellation of satellites** in space which act as precise reference points. The receiver uses data from a **minimum of four satellites** above the mask angle (the lowest angle above the horizon at which it can use a satellite).

In most of the airplanes, the GPS signal is received by one of the following instruments:



GPS text receiver



Garmin GPS receiver in flight simulator:

7. The TACAN equipment

The TACAN (TACtical Air Navigation) is a navigation system used by military aircraft. It provides the pilot with bearing and distance (slant-range) to a ground or ship-borne station. It is a more accurate version of the VOR/DME system used for civil aviation.

The TACAN operates in the UHF band and its frequency ranges from 960 to 1215 MHz. Its characteristics allow simpler and smaller emitters compared to VOR. This makes possible its installation on a building, a large truck, an airplane, or a ship, and be operational in a short period of time.

The DME portion of the TACAN system is available for civil use.
At **VORTAC** facilities where a VOR is combined with a TACAN, civil aircraft can receive VOR readings. Aircraft equipped with TACAN avionics can use this system for en-route navigation as well as non-precision approaches to landing fields.

The TACAN is not a default equipment in our flight simulators software.

8. The LORAN equipment

The **LORAN** (**LOng RAnge Navigation**) is a hyperbolic radio navigation system developed in the US during World War II. It is based on the calculation of the time difference between two radio pulses, emitted by two ground stations, one master and one slave, typically separated by about 1000 km. Each pair broadcast at one of four frequencies (1.75, 1.85, 1.9 or 1.95 MHz).

LORAN systems have been decommissioned.

The LORAN is not a default equipment in our flight simulators software.

9. The OMEGA equipment

OMEGA is an old navigation system which enabled ships and aircraft to determine their position over a very large range (8000 Km) by receiving Very Low Frequency (VLF) radio signals in the range 10 to 14 kHz, transmitted by a network of fixed terrestrial radio beacons, using a receiver unit.

It became operational around 1971 and was shut down in 1997 in favour of the GPS system.

The OMEGA is not a base equipment in our flight simulators software.

10. The MLS equipment

The **Microwave Landing System (MLS)** is an all-weather precision landing system originally intended to replace or supplement the ILS.

MLS has a number of operational advantages, including a wide selection of channels to avoid interference with other nearby airports, excellent performance in all weather, small footprint at the airports, and wide vertical and horizontal capture angles that allows approaches from wider areas around the airport. It operates on frequencies around 5 GHz and has a range of around 20 Km.

In real life, it is presently used only at the London Heathrow (EGLL) airport.

The MLS is not a default equipment in our flight simulators software.

11. The INS equipment

The **Inertial Navigation System** (**INS**) is a navigation aid that uses a computer, motion sensors (accelerometers) and rotation sensors (gyroscopes) to continuously calculate via dead reckoning the position, orientation, and velocity (direction and speed of movement) of an aircraft without the need for external references.

The INS is not a default equipment in our flight simulators software. But it can be present in some addons.

12. The HUD equipment

The **Head-Up Display** (**HUD**) is a transparent display that presents navigational data without requiring the pilot to look away from his usual viewpoints.

In most cases it displays airspeed, altitude, a horizon line, heading, turn/bank and slip/skid indicators. In some aircraft (the Boeing 787, for example) the HUD displays data from guidance computation for low visibility take-off and low visibility approach, coming from the same flight guidance computer that drives the autopilot.

The HUD is not a default equipment in our flight simulators software. But it can be present in some addons.

13. The FMS equipment

The **Flight Management System** (**FMS**) is a specialized computer system that automates a wide variety of in-flight tasks.

Its main function is the in-flight management of the flight plan: using various sensors (such as GPS and INS often backed up by radio-navigation aids) to determine the aircraft's position, the FMS can guide the aircraft along the flight plan. From the cockpit, the FMS is normally controlled through a Control Display Unit (CDU) which incorporates a small screen and keyboard or touchscreen. The FMS sends the flight plan for display to the Electronic Flight Instrument System (EFIS), Navigation Display (ND), or Multifunction Display (MFD).

The HUD is not a default equipment in our flight simulators software. But it can be present in some addons.

13.1. The navigation database

All FMS contain a **Navigation DataBase** (**NDB**). The navigation database contains the elements from which the flight plan is constructed.

These are defined via the ***ARINC 424*** standard. The navigation database is normally updated on ground every 28 days, in order to ensure that its contents are current. Each FMS contains only a subset of the ARINC data, relevant to the capabilities of the FMS.

The NDB contains all of the information required for building a flight plan, consisting of:

- Waypoints/Intersections
- Airways
- Radio navigation aids
- Airports
- Runways
- Standard procedures (SID, STAR, IAP, holds)

Waypoints can also be defined by the pilot along the route or by reference to other waypoints with entry of a place in the form of a waypoint (e.g. a VOR, NDB, ILS, airport or waypoint/intersection)

The FMS is not a default equipment in our flight simulators software.



NAVIGATION INTRUMENTATION – ADF

1. Introduction

The Automatic Direction Finding (ADF) equipment on-board of aircraft is used together with the Non Directional Beacon (NDB) transmitters installed on the ground. The on-board ADF is able to receive and decode NDB signals through an antenna system and a HF receiver to provide pilots with an indication of the relative position shown in the instrument.

A Non Directional Beacon, abbreviated 'NDB', is a ground installation consisting of a LF transmitter which transmits vertically polarized radio signals continuously and in all directions.

This radio navigation system is used mainly for Instrument Flight Rules flights (IFR). However, during VFR flights it can be quite useful in order to check aircraft's position.

This system is an old radio-aid system which is getting replaced slowly with more modern and accurate systems such as VOR or even GPS systems.

2. Ground equipment: NDB

NDBs transmit their signals in the Low Frequency (LF) and Medium Frequency (MF) bands, operating from 190 to 1750 KHz. The radio signal propagates as a surface wave does, which provides quite a big amount of errors on the ADF which may sometimes cause the instrument indication not to be reliable. With the purpose of suppressing those errors as much as possible, they normally transmit between 250 and 450 KHz.
NDB errors may not be found on our perfect simulators.
Each NDB has its own frequency and all of them are identified by names consisting of two or three letters or an alphanumeric combination.

There are two types of NDB, regarding the purpose for which they have been installed:

- Locator NDBs (L): These are low power NDBs located near an aerodrome. They are useful to simple design instrumental approach procedures for this airfield, or sometimes arrival or departure reference beacon. They can be also co-located with ILS system markers, which usually provide distance to touchdown when no DME is associated with the ILS. Locators range varies between 10 and 25 NM.
- En-route NDBs: These are higher powered NDBs which provide a greater range.
  - Low power: used for IFR procedures not so near of an aerodrome, as a holding facility or en-route station, providing a range up to 50 NM.
  - High power: used only for en-route navigation with ranges of more than 50 NM.

NDB can transmit other information for local aircraft like:

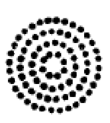
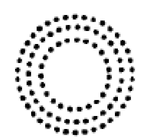
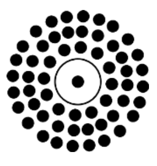
- ATIS: Automatic Terminal Information Service
- AWIS: Automatic Weather Information Service
- AWOS: Automated Weather Observation System
- ASOS: Automated Surface Observation System
- VOLMET: Meteorological Information Broadcast
- TWEB: Transcribed Weather Broadcast



Figure: ground NDB installation

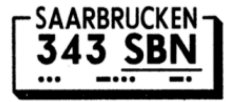
3. NDB on charts

The symbol of NDB radio navigation beacons on charts can be like the figures below

Associated with the NDB figure, you can have additional information written in a rectangle:

- Full clear name of the NDB
- Frequency in kHz
- 2 or 3 letter call sign of the NDB
- Morse code of the call sign





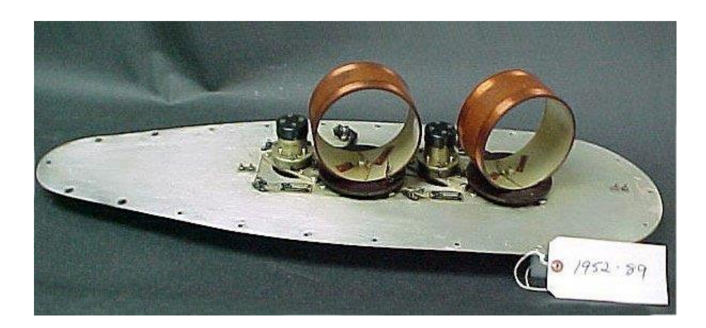
4. On-board equipment: ADF

The Automatic Direction Finder – ADF - when tuned to a selected NDB frequency, is the on-board equipment that determines the relative bearing (RB) from the aircraft to the ground beacon or station.

The relative bearing (RB) is the number of degrees measured clockwise between the heading of the aircraft and the direction from which the bearing is taken.
The relative bearing must be corrected with the aircraft position's variation and heading to obtain the magnetic bearing (MB) (the variation is the difference between the true north and the magnetic north).

Typical ADF equipment includes:

- 2 antennas:
  - Sense aerial: is the non-directional antenna that receives signals from all directions.
  - Loop aerial: is the rotating antenna that bests receives signals from only two directions.
- Receiver: the control unit, usually found next to radio panels.
- Indicator instrument: the instrument where the information is presented to pilots. It does not normally have any form of failure warning system such as a flag, so great care must be taken.



The NDB transmits signals in all directions that reach airborne ADF's loop and sense antennas. When both inputs are processed together, the equipment is able to display the relative bearing on the indicator instrument.

4.1. Frequency selector

The ADF receiver is the control unit where pilots select NDB frequencies from which they want to obtain the bearing.

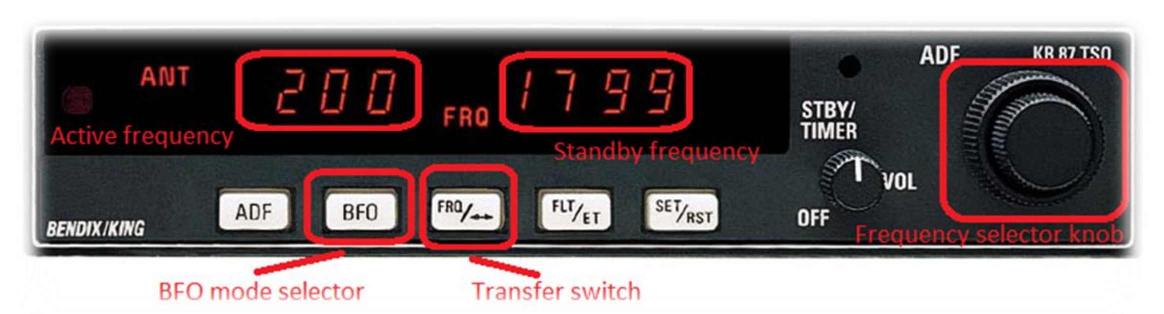


ADF equipment has its own controls:

- Frequency selector: used to select the NDB frequency. It can be digital or analogic, depending on the equipment. Frequencies are tuned by rotating a knob until the wanted frequency is obtained.
- BFO (Best Frequency Oscillator): it must be turned on when identifying a non A1A beacon, so that the aural identification can be heard.
- Antenna mode:
  - ANT: only sense aerial will work
  - NDB/ADF: both sense and loop aerials will work. This mode is the most advisable
  - LOOP: only loop aerial will work. It usually is linked to another switch called 'Loop L/R' which with the aerial can be rotated left or right.

Depending on the equipment, there could also be two displays showing the ACTIVE and STANDBY ('SBY') frequencies. In this type of control units, the frequency is first selected on the STANDBY frequency display and then transferred to the ACTIVE frequency using the transfer switch (XFR) located normally between the displays.





Figures: 2 examples of ADF frequency selector:

4.2. Indicator instruments

Relative bearing from NDBs can be shown in two different instruments:

- Radio Bearing Indicator (RBI)
- Radio Magnetic Indicator (RMI)

Basic instruments consist of a compass rose with one needle that may indicate Relative Bearing (RB) or Magnetic Bearing (MB), depending on the instrument. The head of the needle indicates bearing TO the station and the tail of the needle indicates bearing FROM the station.

4.2.1. Radio bearing indicator with fixed card

It only has one needle and a fixed (not movable) compass rose. It always indicates heading North at the top of the instrument.



The moving needle indicates the Relative Bearing (RB) to the station, relative to the longitudinal axis of the aircraft (fore and aft axis). That Relative Bearing (RB) is read clockwise from 0º until the value the needle is pointing.

This is the simplest instrument and so its usage is not easy since the Magnetic Bearing (MB) is not shown at first glance. Relating to the current heading, the pilot will need to check the relative bearing and calculate the Magnetic Bearing (MB) each time.

Magnetic Bearing (MB) = Relative Bearing (RB) + aircraft heading.

4.2.2. Radio bearing indicator with movable card



Similar to the radio bearing indicator with fixed card, this instrument has the advantage to have a compass rose which can be rotated manually by the pilot.

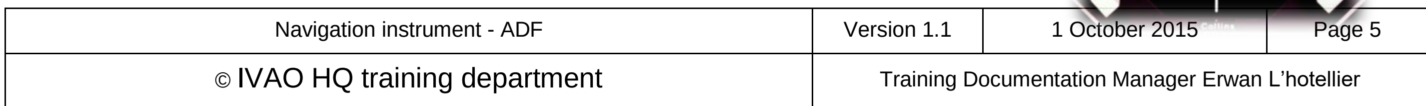
So the aircraft's current heading can be set on the top. This allows the instrument to show directly the Magnetic Bearing (MB), which eases the pilot's work.

In the figure, the movable card was put at a heading 345°. In consequence the NDB magnetic heading is 060°.

4.2.3. Radio magnetic indicator (automatic)

This is an advanced instrument as it automatically rotates the compass rose to represent the current aircraft heading at the top. The Magnetic Bearing (MB) can be obtained easily.

The RMI has one or two needles which can be used to indicate navigation information from either the ADF or the VOR receivers. Both needles are different in appearance, one of them operating with NAV 1 or ADF 1 radio and the other one operating with NAV 2 or ADF 2 radio.



There are two switches that allow the pilot to change each needle source from VOR to ADF or from ADF to VOR.

4.2.4. Electronic horizontal situation indicator EHSI

In more complex instruments mounted on bigger or commercial airplanes, the ADF might be integrated into glass cockpits EHSI where NDB bearings may be shown in the Navigation Display.



Figure: ADF is the blue arrow

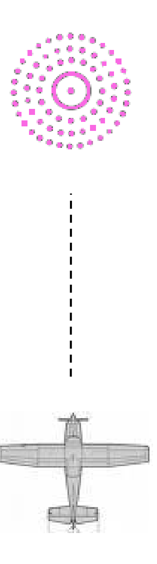
4.3. Relative position between aircraft and NDB

The head of the needle indicates bearing TO the station and the tail of the needle indicates bearing FROM the station. The needle is not in function of aircraft heading.

4.3.1. Inbound NDB

The needle on the ADF is pointing north. Then the NDB is in front of the aircraft.

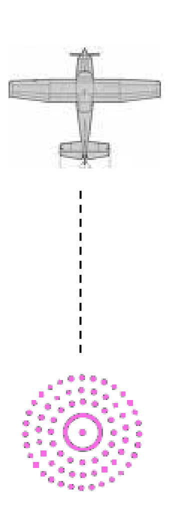




4.3.2. Outbound NDB

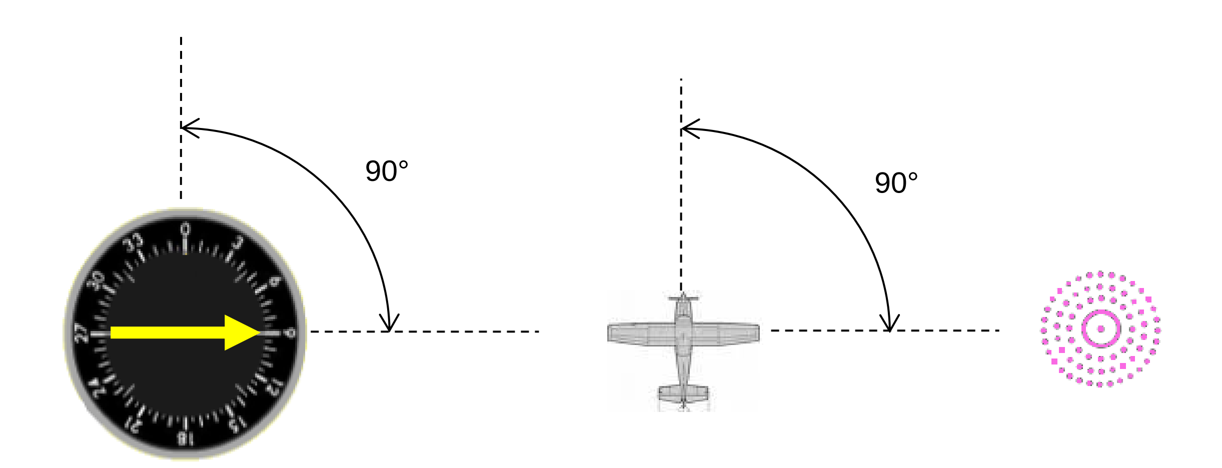
The needle on the ADF is pointing south. Then the NDB is behind the aircraft.





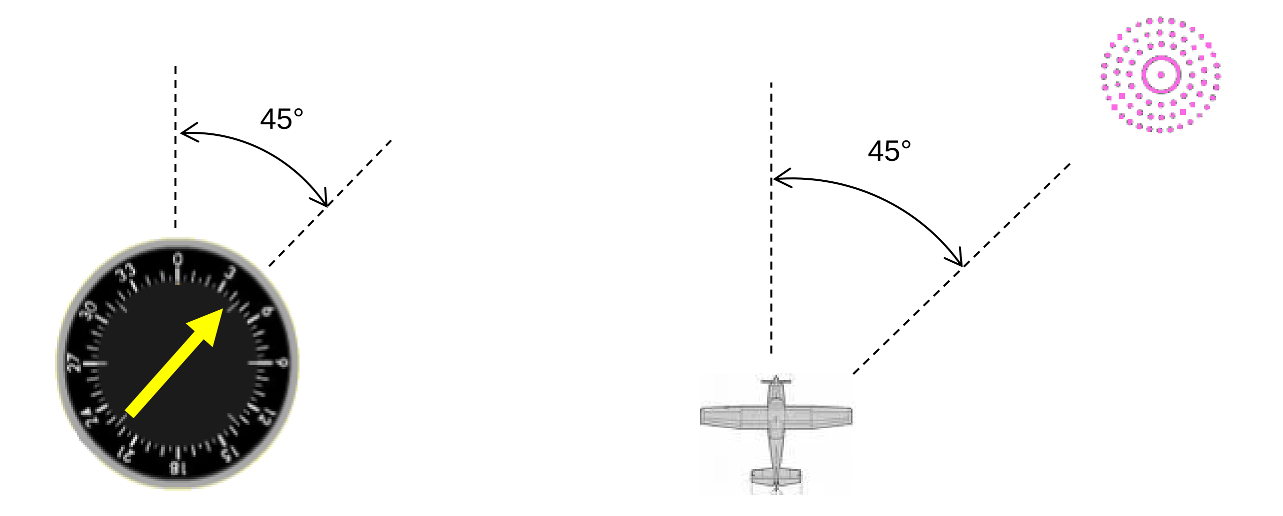
4.3.3. Lateral NDB

The needle on the ADF is pointing 90°. Then the NDB is on the right of the aircraft.



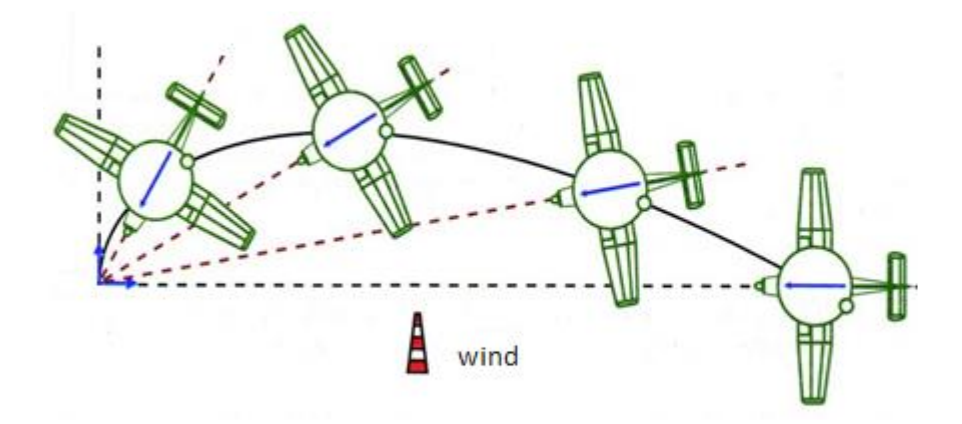
4.3.1. 45° track

The needle on the ADF is pointing 45°. Then the NDB is on the right of the aircraft.



5. Wind effect

When following a NDB navigation aid with presence of cross wind, if you maintain only the ADF at the top position of the instrument, your heading will increase or decrease like the image below.



In this case, you do not make a direct and follow the same NDB track.



NAVIGATION INTRUMENTATION – DME

1. Introduction

Distance Measuring Equipment (DME) is defined as usually coupled with a VOR or an ILS beacon to enable aircraft to measure their position relative to that beacon.

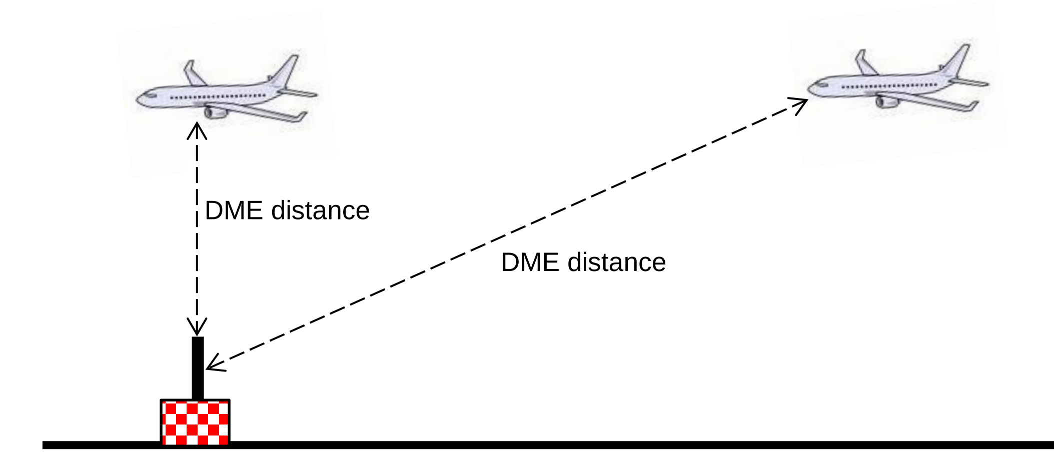
Distance Measuring Equipment (DME) is defined as a combination of ground and airborne equipment which gives a continuous slant range distance-from-station readout by measuring the time-lapse of a signal transmitted by the aircraft to the station and responded back.

DMEs can also provide groundspeed and time-to-station readouts by differentiation.

2. DME ground equipment

DME ground and on-board equipment use the UHF radio frequency band between 962MHz and 1213MHz.

An aircraft can compute its distance to the beacon from the delay of the signal perceived by the aircraft's DME equipment using the speed of light.





The distance measured by the aircraft is the direct path between the aircraft and the antenna of the DME. It is not the ground distance!

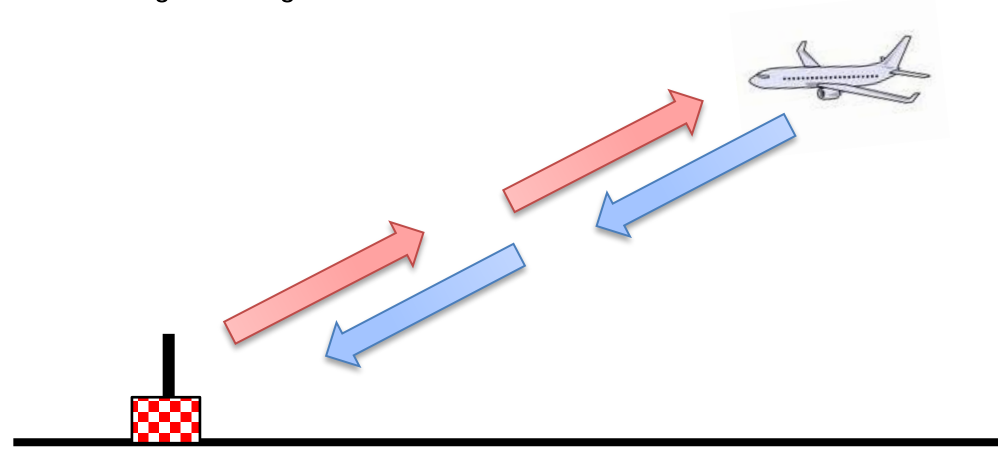
When an aircraft is above the DME, DME indicates the height of the aircraft and not zero.

Figure: a DME installation near an airfield.

DME works like a receiver and re-emitter like a transponder:

- The aircraft transmits a paired pulse spaced about 12µs or 36µs on the UHF frequency.
- The DME on the ground receives it and transmits with a constant delay of 50µs on an UHF frequency (with ± 63 MHz offset) a paired pulse spaced 12µs or 36µs
- When 50% of the signals emitted have been received by the aircraft's receiver, aircraft instrument can compute the signal in order to find the propagation time and then, calculate the distance.

The aircraft has also two modes for DME tracking: One for searching the station and another for tracking the station using fewer signals.

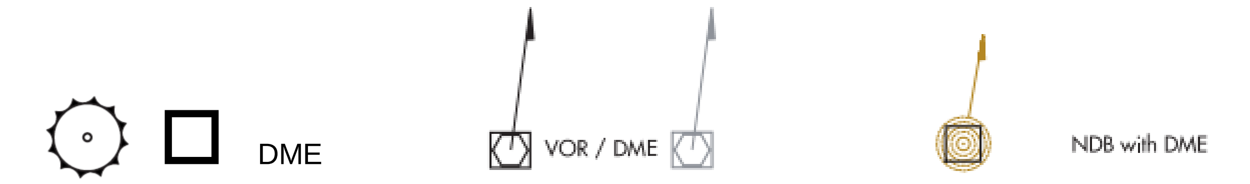


The need of bilateral communication between the base DME station and aircraft implies that the DME station has a limit of about one hundred aircraft in order to prevent the overload of the station. The DME station will adjust its receiver sensibility in order to filter the farthest aircraft.

The precision of the measure is 0.25 NM ± 1.25% of the distance calculated.

3. DME on charts

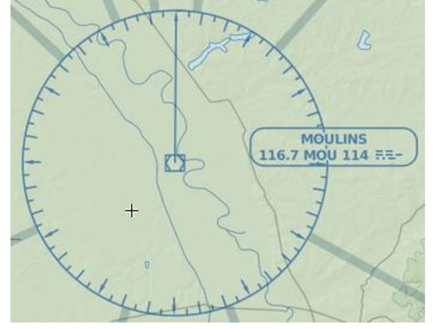
The symbol of the DME radio navigation beacon on charts is usually a square.



Associated with the DME figure, you can have additional information written in a rectangle:

- Full clear name of the DME
- Frequency in MHz and/or DME channel
- 3 letter call sign of the DME
- Morse code of the call sign





4. DME on-board equipment

4.1. Frequency selector

The NAV frequency selector is the control unit where pilots select DME frequencies.
The DME frequency is usually "paired" with VOR or ILS or localizer (LOC) frequencies. Selection of the appropriate VOR or ILS frequency automatically tunes the DME attached (if existing).





Figures: 2 examples of a DME/NAV frequency selector:



Figure: example of a frequency selector located in FMC

4.2. Indicator instruments

There are several types of instruments for receiving a DME:

4.2.1. Standalone instrument

A standalone instrument is an instrument that displays only DME related information.
This instrument can be like the example below and can be found on beechcraft propellers for example.



The information displayed are:

- Distance in NM between aircraft and DME station
- Speed of the aircraft in Knots
- Time to reach the station if you navigate direct to the DME station

4.2.2. DME displayed on RMI instrument

In more complex aircraft, like business jet and some airbus, cockpits have dual RMI equipment installed. This equipment is paired with a VOR/NDB remote magnetic indicator, and when a DME station can be found, the distance in NM is displayed at the top of the istrument.



Figure: Dual RMI of airbus aircraft

4.2.3. DME displayed on electronic navigation instrument

In many modern jets and propeller aircraft, electronic navigation instruments are usually used. These modern electronic navigation instruments are all-in-one instruments to display:

- VOR and paired DME distance
- ILS and paired DME distance
- NDB
- Navigation fixes
- FMC route
- Traffic (TCAS)
- Weather





Figure: Two examples of electronic navigation instruments: Boeing like and Beechcraft like



VFR FUEL MANAGEMENT FOR GENERAL AVIATION

1. Introduction

A flight shall not be commenced unless taking into account both meteorological conditions and any delays that are expected in flight, and the aeroplane carries sufficient fuel and oil to ensure that it can safely complete the flight.

2. VFR Fuel and oil supply

When the flight is conducted in accordance with the visual flight rules, the amount of fuel to be carried must permit:

- For VFR flight during day time, the flight to the aerodrome of intended landing with an additional flight time for at least **30 minutes** at normal cruising altitude
- For VFR flight during night time, the flight to the aerodrome of intended landing with an additional flight time for at least **45 minutes** at normal cruising altitude

3. Practical VFR

Before departing with a light aircraft, in real flight, the pilot will fill the fuel tanks at the maximum especially if the weather is not expected to be good.

It prevents the “lack of fuel” distress during unexpected re-routing, holding or diverting to any alternate airfield.



FLYING THE CIRCUIT WITH A C172

1. Introduction

This document describes how to handle a basic Cessna 172 in a circuit pattern.

Remember that, while flying the pattern, **the pilot shall maintain visual with the runway all the time**. This document is a summary of some real practices but will not show all aircraft and flight preparation as well as some Cessna 172 specifics.

This document does not cover the phraseology used between pilot and ATC (see VFR phraseology).

2. Start-up on apron

When we enter a Cessna 172, all switches are in the "off" position according to the screen below.



- **Power on** your aircraft using the battery switch [1]
- Push the red mixture command [2] to the full rich position
- Power on the strobes light using switch [3] in order to warn others that you are going to start
- Be sure that the brakes are pressed or park brake is set.
- Verify that the throttle command [6] is in idle position.
- Put magneto [5] on Both (1+2) position, then Start position.
- Monitor engine speed. It shall stabilize around 500 to 600 rpm.
- Set alternator to ON using switch [1] and avionics using switch [7]

3. Taxi to the runway

Get the taxi clearance from the air traffic controller (ATC) and study the airport charts in order to comply with ATC taxi instructions. Release the brakes and set a little power in order to start taxi.
The speed shall not exceed 20 knots. When approaching the holding point (yellow marks on taxiways), stop the aircraft using the brakes.

4. At holding point

- Check battery and alternator switches are set to ON **[1]**
- Check magneto is set to both (1+2) **[2]**
- Check red mixture command **[3]** is set to full rich position
- Set flaps **[4]** to 10° only advised for rough and soft strips with obstacles ahead
- Check all flight commands (Aileron, Elevator, Rudder)
- Set trim to take-off position
- Check Altimeter value and setting
- Set navigation and landing lights **[6]**
- You can prepare your navigation frequencies in the frequency panel if needed
- You can perform an engine test with brakes on and monitor that the engine speed is reacting well
- Tell ATC that you are ready for departure



5. Lining-up

After receiving departure clearance:

- Line-up on the runway
- Check the heading indicator (runway QFU) and set if needed
- Set your squawk mode Charlie (Tx position on IvAp) **[8]**

6. Take-off

After receiving take-off clearance:

- **Set throttle command to full position**
- **Verify** engine power. It shall be 2600 rpm. If power is below that value abort the take-off.
- Release brakes (if the runway is long, you can release the brake before setting the power)
- When aircraft is moving, check that the airspeed indicator is active (speed shall increase)
- Maintain runway centreline.
- When reaching the rotation speed **55 knots**, smoothly pull back the elevator command in order to lift the nose of the aircraft. (Do not pull back too much and adjust the pitch to control the speed)

7. Initial Climb

- After take-off, maintain runway track
- Maintain minimum **70 knots** then accelerate to **75/80 knots.**
- When passing **300ft AAL, set flaps to 0°** and continue to **adjust the pitch to control the** speed and **trim** the aircraft

If the speed decreases, lower the attitude and trim the aircraft to maintain 80 knots. If the speed increases, raise the attitude and trim the aircraft to maintain 80 knots. The aircraft is in trim if no inputs are required to maintain the speed.

Be aware you must act smoothly on the elevator command.
AAL is the height above the airfield level. Do not confuse with altitude.

8. Crosswind leg

When passing 500 ft AAL or the end of the runway:

- Turn **left** on crosswind (90° turn)
- Continue climb until 1000 ft AAL, remaining perpendicular to the runway
- Reaching **1000 ft AAL**, lower to attitude gently to achieve a smooth level off.
- You are ready to **turn to downwind leg**.



Usually, you must perform a left hand circuit pattern at 1000 feet AAL.
Sometimes on VFR charts, other restrictions may apply: right hand circuit, other altitude, and/or non-standard legs: all the time consult the charts in order to comply with the published circuit.

9. Downwind leg

Now, you are ready to turn on downwind leg:

- Initiate the left turn (90° turn)







Now, we are on left hand downwind leg.

- **Reduce throttle while maintaining pattern altitude** (trim as needed). You can preset engine power to 2100 rpm. Maintain constant speed.
- **Keep a constant distance from the runway all along the downwind leg**
- Inform ATC that you are established on downwind leg

You do not need to reach maximum speed on downwind. Maintaining speed at 85 knost could be a good target.

10. End of downwind leg

When crossing the runway threshold on your left, prepare the aircraft for final:

- **Reduce power around 1900 rpm**
- Set **flaps to 10°**
- Adjust throttle in order to maintain speed around **70/80 knots**



11. Base leg

When the touchdown point on the runway is on your ¾ back (7 to 8 o'clock):

- Turn **left** on base leg (90° turn)
- **Reduce power to 1700rpm and set flaps 20°.**
- **Descent will start with approximatively -500 ft/min vertical speed**, at **70 to 80 kts IAS**





Starting the last turn for final does not obey to any specific rule. Estimate it by yourself using visual references (runway threshold or touchdown position from cockpit view).

Be aware of wind effects when turning on final as well as for correctly flying the pattern legs. For example:
If there is head wind on base leg, you must delay the last turn.
If there is tail wind on base leg, you must anticipate the last turn.

12. Final leg

Usually, after the last turn, you must be around 500ft AAL.

- Once established on final, **follow the PAPI or VASI indicator** if present, until runway threshold
- If you are not cleared to touch and go or land by ATC (if present), it is time to report that you are on final.



Continue the final approach:

- Set flaps to **full**.
- Reduce speed around **60 to 65 knots** and adjust trim as needed. At this stage, power should be around 1700rpm.
- Change power according to the **descent profile** (Descent rate shall be around **-350 ft/min**).

When passing the threshold your point of reference should transition from the touchdown zone to the end of the runway to judge the flare and power reduction to idle (keeping level will require increasing amounts of back pressure on the yoke).

While on the ground, keep the runway axis until it reaches the ground manoeuvring speed, then vacate the runway using a taxiway.

13. On ground

After vacating the runway set your squawk mode to stand by position (STBY).

- If ATC is active, announce that the runway is vacated and wait for taxi clearance.
- Then, taxi to the general aviation apron. Announce when you leave the ATC frequency.
- Then perform a complete shutdown of the aircraft:
- Set park brake
- Shutdown lights and avionics
- Cut off mixture
- Set magneto to OFF, alternator and battery switches to OFF

DIRECT TO A NDB

1. Introduction

This documentation will present a practical method to use ADF in a Cessna 172 aircraft to make a direct to a NDB – non directional beacon.
A NDB is a beacon which can help the pilot to navigate along great distance.

2. Chart

This is a chart showing:

1. the aircraft coloured in orange
2. non directional beacon – NDB: MUSKOKA YQA 272
3. MUSKOKA airfield: CYQA



The goal of the example is to go direct YQA NDB from the present position

3. ADF

The ADF is the instrument inside the cockpit which displays the NDB information.
The basic Cessna 172 has a fixed or rotatable indicator's compass.
0° is straight up the nose of the aircraft (when the rotatable indicator has not been moved).

The most important concept in ADF navigation is that the needle always points to the station.
The ADF indicator shows the beacon's relative bearing to the aircraft's heading.

When the needle points to 12 o'clock, it means that the beacon is straight ahead.

The standby position when the ADF does not receive any signal from any NDB is like this picture:

- the yellow arrow points to the right at 3 o'clock (90°)



If your aircraft is flying and the yellow arrow is still in its position, there are two possibilities:

1. ADF is not tuned to the right frequency
2. Aircraft is too far from the NDB beacon to receive the signals

4. Tune cockpit

The first step for the pilot is to tune the instruments:

1. Tune the NDB frequency on the ADF frequency selector
2. Verify that the ADF instrument is updated (arrow was moving from standby position to the beacon)



After tuning to the NDB frequency, the arrow of the ADF is moving and points to the NDB.

Low frequency beacons can sometimes be received at great distances. It is very important to verify the Morse-code identifier of the station to be certain you are navigating from the proper beacon.

5. Turn to the beacon

If order to turn to the beacon we shall turn the heading toward the ADF arrow and stop the turn when the arrow points to the top of the ADF (0°) like the figure below.



If we check the route flown by the aircraft after this manoeuvre on the map, you can see that the aircraft is going directly to the wanted NDB.



6. Over the NDB

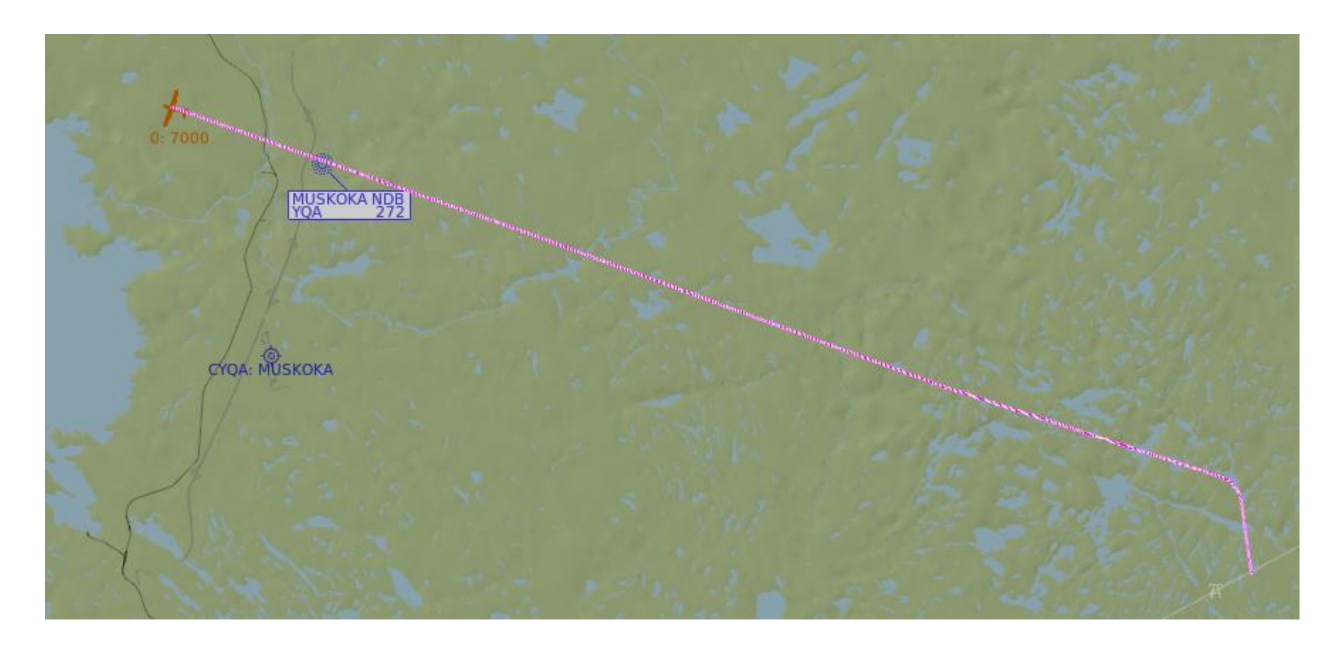
When approaching the NDB with your aircraft, since the ADF will always turn to the direction of the beacon, you can see in the cockpit the quick move of the arrow which points from top position to bottom position.

The figure below shows two intermediate positions and the last position after flying over the NDB.



7. Go forward from the beacon

If you maintain the heading, you continue your route outbound the NDB station.



If we check the cockpit view in that position, we find the ADF arrow pointing to the 6 o'clock position and pointing towards the NDB.





DIRECT TO A VOR

1. Introduction

This document presents a practical method to use the VOR receiver in a Cessna 172 aircraft to make a direct to a VOR – VHF Omnidirectional Range.
A VOR is a beacon which can help the pilot to navigate along great distance.

2. Chart

This is a chart showing:

1. the aircraft coloured in orange
2. VOR – DME : TRENT TNT 115.7MHz
3. NDB : WHI 368kHz
4. Airfields: EGOE Ternhill ; EGBD Derby ; EGCT Tilstock



The purpose of the example is to go direct to the TNT VOR from the present position

3. VOR receiver

The basic Cessna 172 has a VOR rotatable course display indicator - CDI.

The standby position of the instrument when the aircraft does not receive any signal from any VOR is like this picture:



- NAV red flag (NAV, NAV1 or NAV2) is visible
- GS red flag can be visible if your instrument is capable to receive an ILS glide path

If you do not receive a VOR, you must check that:

- You are not tuned to the right frequency (do not mix up 2 VOR indicators)
- You are out of range

When the aircraft does receive any signal from the tuned VOR, the instrument is like this picture:



- NAV red flag is not visible
- GS red flag can be visible if your instrument is capable to receive an ILS glide path



Using a VOR, you can track a specific magnetic radial to the VOR beacon.

This radial is shown on the top of the instrument indicated by the yellow arrow:

- The instrument indicates 22 = 220° radial.

4. Tune cockpit

The first step for the pilot is to tune the instruments:

1. Tune the VOR frequency on the NAV frequency selector of your choice
2. Verify that the VOR instrument is updated (arrow moved from standby position to the beacon)

After tuning the VOR frequency, the red flag must disappear.

.



The VOR can sometimes be received at great distances. It is very important to verify the Morse-code identifier of the station to be certain you are navigating from the right beacon

5. Tune the course on navigation instrument

There are different ways to make a direct to a VOR but, we will give you one of the simplest methods.

The simplest method is to search with the navigation instrument which radial you are currently on.

1) Turn the OBS selector



2) Turn until you will have the white triangle pointed to the **TO** mark and Turn until the vertical needle is centered.



BAD: needle centred but indicator shows FROM



BAD: TO indicator is showing but needle not centred



GOOD: well done: TO indicator and needle centred

6. Turn to the beacon

When your instrument is tuned, just take the course indication of your instrument and, turn your aircraft toward this course: Heading = Course.

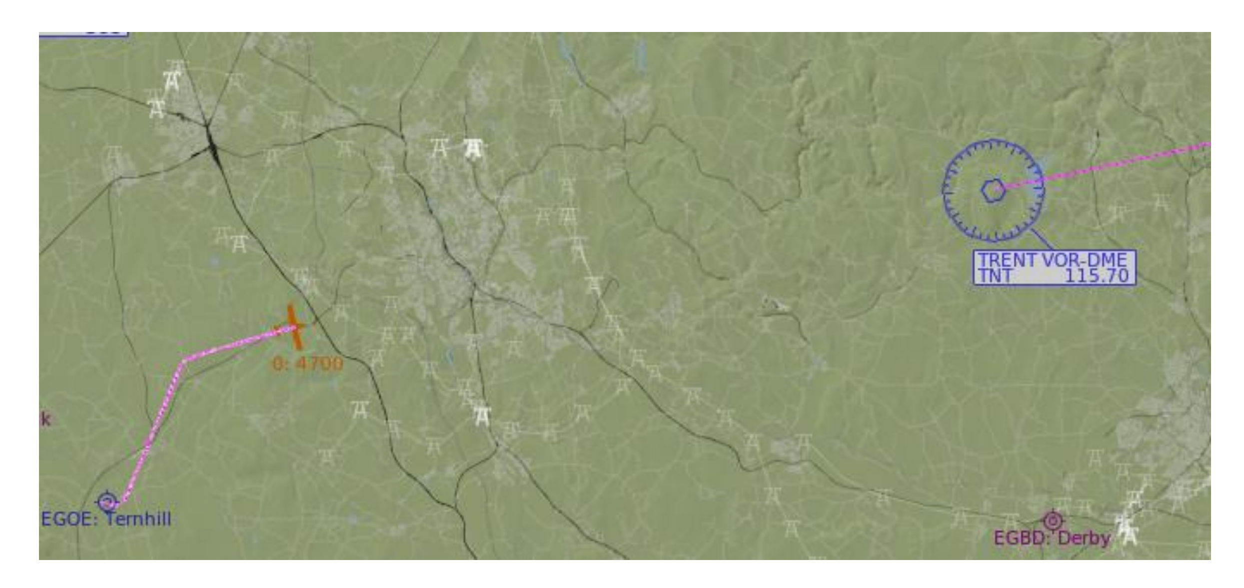


In our example, Course is 80, aircraft turn to 080° heading.

After this turn, the needle, like our example above, can move a little to the right or to the left.
You can make some little adjustment:

1) Centre the NAV needle using OBS navigation button again
2) Set heading to the new course indication on your instrument

One minute after this manoeuvre, we can see the progress of the aircraft on the charts:



7. Mind the wind effect

The VOR navigation using CDI and course selector is precise. If there is a crosswind component, the aircraft may leave the radial (aircraft is 'pushed' by the wind off the selected radial).



In order to keep the same radial, just perform small adjustments using your heading only!

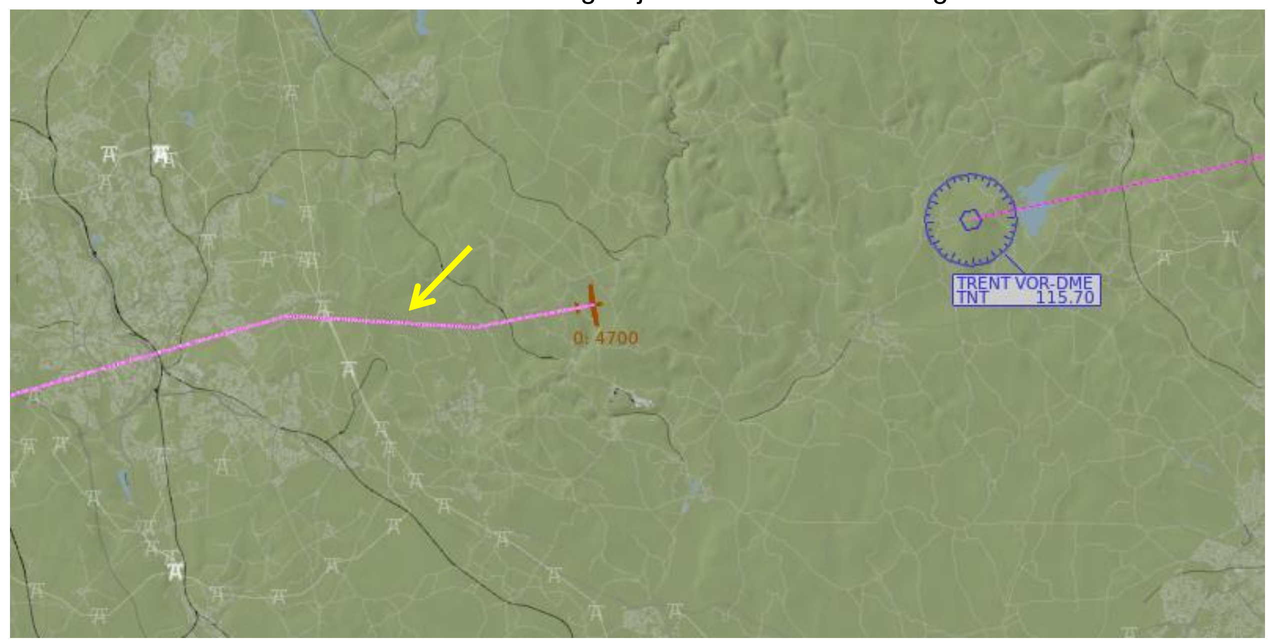
1) Turn in direction of the needle (in our example to the right) in order to centre the needle.
2) When the needle is centred, adjust your heading again to the selected navigation course.

Of course, you can compensate for the wind effect by selecting a new heading.



After aircraft manoeuvre and having added some degrees in the heading to compensate wind.

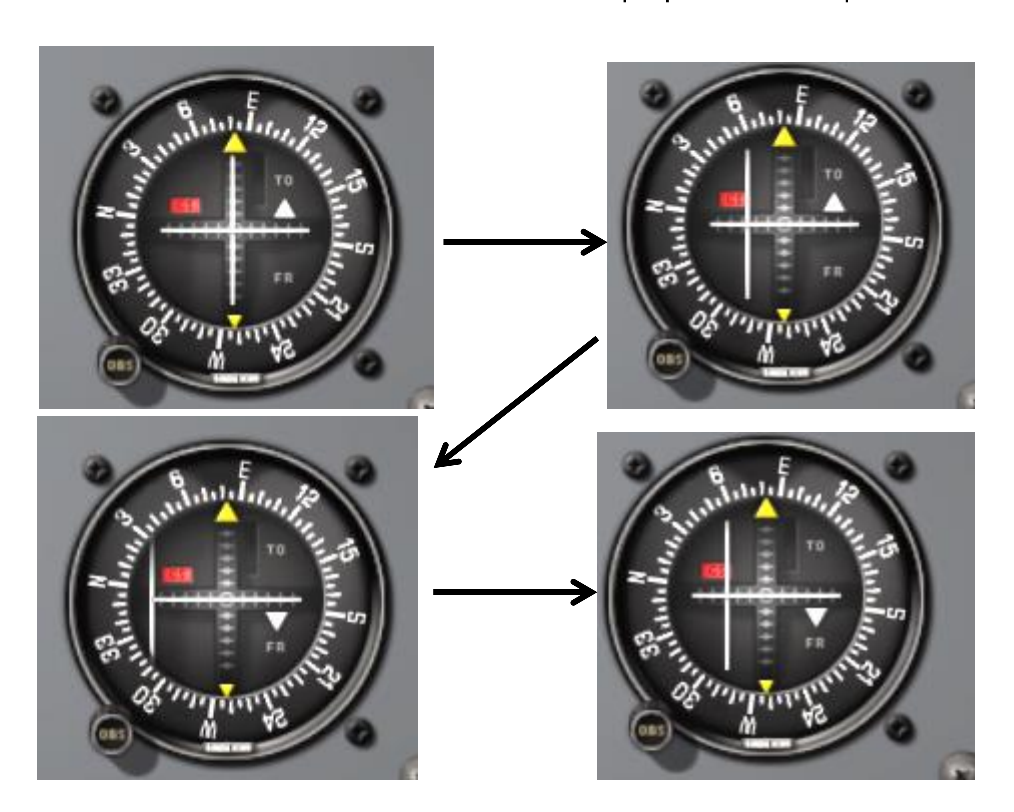
Here is the result after the wind effect and heading adjustment to catch the right course:



8. Overhead the VOR

When approaching the VOR, the needle will move to one direction quickly. If you don't want to change direction, then do not touch heading and navigation instrument.

Your aircraft is in the 'silent cone'. When an aircraft is overhead a VOR, the information given by the beacon is not correct. You must wait a little in order to retrieve proper VOR reception.





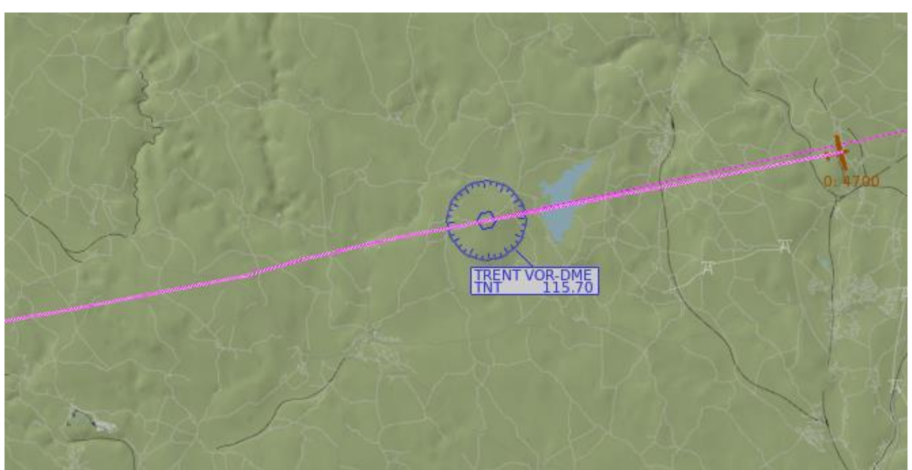
After crossing the VOR, check that the white triangle moved to the **FROM** (FR) indicator

9. Going forward from the beacon

If you maintain the heading, you continue your route outbound the VOR station. To maintain outbound:

1) Maintain the needle of the VOR navigation instrument centred, and the indicator to FROM position
2) Use the same course heading





Altitude Conversion Table

feets (ft)	meters (m)
100	30.48
200	60.96
300	91.44
400	121.92
500	152.4
600	182.88
700	213.36
800	243.84
900	274.32
1000	304.8
1500	457.2
2000	609.6
2500	762
3000	914.4
3500	1066.8
4000	1219.2
5000	1524
6000	1828.8
7000	2133.6
8000	2438.4
9000	2743.2
10000	3048
11000	3352.8
12000	3657.6
13000	3962.4
14000	4267.2
15000	4572
16000	4876.8
17000	5181.6
18000	5486.4
19000	5791.2
20000	6096
21000	6400.8
22000	6705.6
23000	7010.4
24000	7315.2
25000	7620
26000	7924.8
27000	8229.6
28000	8534.4
29000	8839.2

feets (ft)	meters (m)
328.1	100
656.2	200
984.3	300
1312.3	400
1640.4	500
1968.5	600
2296.6	700
2624.7	800
2952.8	900
3280.8	1000
4921.3	1500
6561.7	2000
8202.1	2500
9842.5	3000
11482.9	3500
13123.4	4000
14763.8	4500
16404.2	5000
18044.6	5500
19685.0	6000
21325.5	6500
22965.9	7000
24606.3	7500
26246.7	8000
27887.1	8500
29527.6	9000
31168.0	9500
32808.4	10000
34448.8	10500
36089.2	11000
37729.7	11500
39370.1	12000
41010.5	12500
42650.9	13000
44291.3	13500
45931.8	14000
47572.2	14500
49212.6	15000
50853.0	15500
52493.4	16000
54133.9	16500

Distance Conversion Table

m	km	NM	SM	ft
1000.00	1.00	0.54	0.62	3280.84
1852.00	1.85	1.00	1.15	6076.12
1609.35	1.61	0.87	1.00	5280.01
304.80	0.30	0.16	0.19	1000.00
5556.00	5.56	3.00	3.45	18228.35
9260.00	9.26	5.00	5.75	30380.58
18520.00	18.52	10.00	11.51	60761.16
92600.00	92.60	50.00	57.54	303805.78
185200.00	185.20	100.00	115.08	607611.57
914.40	0.91	0.49	0.57	3000.00
1524.00	1.52	0.82	0.95	5000.00
3048.00	3.05	1.65	1.89	10000.00
4572.00	4.57	2.47	2.84	15000.00
6096.00	6.10	3.29	3.79	20000.00
9144.00	9.14	4.94	5.68	30000.00
4828.04	4.83	2.61	3.00	15840.03
8046.74	8.05	4.34	5.00	26400.05
16093.47	16.09	8.69	10.00	52800.10
24140.21	24.14	13.03	15.00	79200.15
32186.94	32.19	17.38	20.00	105600.20
48280.41	48.28	26.07	30.00	158400.30
3000.00	3.00	1.62	1.86	9842.52
5000.00	5.00	2.70	3.11	16404.20
10000.00	10.00	5.40	6.21	32808.40
15000.00	15.00	8.10	9.32	49212.60
20000.00	20.00	10.80	12.43	65616.80
30000.00	30.00	16.20	18.64	98425.20
500.00	0.50	0.27	0.31	1640.42
333.33	0.33	0.18	0.21	1093.61
250.00	0.25	0.13	0.16	820.21
200.00	0.20	0.11	0.12	656.17
100.00	0.10	0.05	0.06	328.08
83.33	0.08	0.04	0.05	273.40
50.00	0.05	0.03	0.03	164.04



Pressure Conversion Table

hectopascal (hpa)	inch of mercury (inHg)
1013.25	29.92
980	28.94
990	29.23
995	29.38
996	29.41
997	29.44
998	29.47
999	29.50
1000	29.53
1001	29.56
1002	29.59
1003	29.62
1004	29.65
1005	29.68
1006	29.71
1007	29.74
1008	29.76
1009	29.79
1010	29.82
1011	29.85
1012	29.88
1013	29.91
1014	29.94
1015	29.97
1016	30.00
1017	30.03
1018	30.06
1019	30.09
1020	30.12
1021	30.15
1022	30.18
1023	30.21
1024	30.24
1025	30.27
1026	30.30
1027	30.33
1028	30.36
1029	30.39
1030	30.41
1040	30.71
1050	31.01

hectopascal (hpa)	inch of mercury (inHg)
1013.25	29.92
961.8	28.40
965.2	28.50
968.5	28.60
971.9	28.70
975.3	28.80
978.7	28.90
982.1	29.00
985.5	29.10
988.9	29.20
992.3	29.30
995.6	29.40
999.0	29.50
1002.4	29.60
1005.8	29.70
1009.2	29.80
1009.9	29.82
1010.5	29.84
1011.2	29.86
1011.9	29.88
1012.6	29.90
1013.3	29.92
1013.9	29.94
1014.6	29.96
1015.3	29.98
1016.0	30.00
1016.6	30.02
1017.3	30.04
1018.0	30.06
1018.7	30.08
1019.3	30.10
1022.7	30.20
1026.1	30.30
1029.5	30.40
1032.9	30.50
1036.3	30.60
1039.7	30.70
1043.1	30.80
1046.4	30.90
1049.8	31.00
1053.2	31.10



Speed Conversion Table

km/h	m/s	knot = NM/h	SM/h	m/min
0.19	0.05	0.1	0.12	3
0.37	0.10	0.2	0.23	6
0.56	0.15	0.3	0.35	9
0.74	0.21	0.4	0.46	12
0.93	0.26	0.5	0.58	15
1.11	0.31	0.6	0.69	19
1.30	0.36	0.7	0.81	22
1.48	0.41	0.8	0.92	25
1.67	0.46	0.9	1.04	28
1.85	0.51	1	1.15	31
3.70	1.03	2	2.30	62
5.56	1.54	3	3.45	93
7.41	2.06	4	4.60	123
9.26	2.57	5	5.75	154
11.1	3.09	6	6.90	185
13.0	3.60	7	8.06	216
14.8	4.12	8	9.21	247
16.7	4.63	9	10.4	278
18.5	5.14	10	11.5	309
20.4	5.66	11	12.7	340
22.2	6.17	12	13.8	370
24.1	6.69	13	15.0	401
25.9	7.20	14	16.1	432
27.8	7.72	15	17.3	463
37.0	10.29	20	23.0	617
55.6	15.43	30	34.5	926
74.1	20.58	40	46.0	1235
92.6	25.72	50	57.5	1543
111	30.87	60	69.0	1852
130	36.01	70	80.6	2161
148	41.16	80	92.1	2469
167	46.30	90	103.6	2778
185	51.44	100	115.1	3087
222	61.73	120	138.1	3704
259	72.02	140	161.1	4321
296	82.31	160	184.1	4939
333	92.60	180	207.1	5556
370	102.89	200	230.2	6173
463	128.61	250	287.7	7717
556	154.33	300	345.2	9260
648	180.06	350	402.8	10803
741	205.78	400	460.3	12347

Temperature Conversion Table

Celcius °C	Fahrenheit °F
-70	-94
-58	-72.4
-56	-68.8
-54	-65.2
-52	-61.6
-50	-58
-48	-54.4
-46	-50.8
-44	-47.2
-42	-43.6
-40	-40
-38	-36.4
-36	-32.8
-34	-29.2
-32	-25.6
-30	-22
-28	-18.4
-26	-14.8
-24	-11.2
-22	-7.6
-20	-4
-19	-2.2
-18	-0.4
-17	1.4
-16	3.2
-15	5
-14	6.8
-13	8.6
-12	10.4
-11	12.2
-10	14
-9	15.8
-8	17.6
-7	19.4
-6	21.2
-5	23
-4	24.8
-3	26.6
-2	28.4
-1	30.2
0	32

Celcius °C	Fahrenheit °F
0.0	32
1.0	33.8
2.0	35.6
3.0	37.4
4.0	39.2
5.0	41
6.0	42.8
7.0	44.6
8.0	46.4
9.0	48.2
10.0	50
11.0	51.8
12.0	53.6
13.0	55.4
14.0	57.2
15.0	59
16.0	60.8
17.0	62.6
18.0	64.4
19.0	66.2
20.0	68
21.0	69.8
22.0	71.6
23.0	73.4
24.0	75.2
25.0	77
26.0	78.8
27.0	80.6
28.0	82.4
29.0	84.2
30.0	86
32.0	89.6
34.0	93.2
36.0	96.8
38.0	100.4
40.0	104
42.0	107.6
44.0	111.2
46.0	114.8
48.0	118.4
50.0	122